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U. S. DEPARTMENT OF THE INTERIOR

PROTOTYPE OIL SHALE LEASING PROGRAM

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TRACT C-b

QUARTERLY REPORT #3

(Through May 31, 1975)

Submitted to:

Mr. Peter A. Rutledge
Area Oil Shale Supervisor
Conservation District
U. S. Geological Survey
Grand Junction, Colorado

By:

Ashland Oil, Inc.
Atlantic Richfield Company
Shell Oil Company, Operator
The Oil Shale Corporation

JULY 15, 1975

SHOUT
SHARE
IT

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Alluvial Well Pump Test

Alluvial Well Pump Test

Lower Aquifer Pumping Test

Quarterly Report #2 contains a detailed description of the objectives and history of the upper zone phase of the aquifer pumping test at AT-1. It was stated that the upper zone test was terminated in mid-January when a drilling rig was brought back to the site, and AT-1 deepened. This action, in fact, began the preparation for testing the lower zone. The test well AT-1 was drilled to the base of the mine zone and casing was installed and cemented in place. The well was then drilled an additional 270 feet, downward into the "lower zone aquifer." A pump with water production capability of 150 gallons per minute was installed at a depth of 1430 feet below ground surface. (It was determined during the deepening of AT-1 that the lower aquifer could not sustain rates in excess of 150 gpm. The upper aquifer, by comparison, was capable of yielding greater than 400 gpm.)

Water produced during the deepening operation had a relatively low dissolved solids content, 1500 mg/l and a fluoride content of approximately 20 mg/l. This was similar in character to waters directly above the Mahogany zone in the upper aquifer. During the test, fluoride and boron levels averaged 20 mg/l and 1 to 2 mg/l, respectively. During the lower zone test, the dissolved solids content of production water never exceeded 1200 mg/l.

Background pressure readings were taken for several days before the test was actually commenced. Almost immediately, however, an equipment problem forced a restart. After restart, the test well maintained a rate of approximately 120 gpm for 17 days. At that time, the generator unit failed and the initial pumping phase of the test was terminated. A recovery period lasted for eight days and was followed by a pulse-pumping phase before final shut-in. A complete chronology of events for the lower aquifer test is given in Table II B-51.

An overview of pressure response data generated during the lower aquifer test revealed that strong anisotropic or directional permeability exists. The orientation of this anisotropy in the lower aquifer can be described as following the general direction of AT-1 to SG-6. This is approximately normal to the directional permeability shown in the upper zone test. Computer analysis has not been initiated as yet because pressure data are still being reduced and will not be available in suitable format for some time. Manual plots and interpretation of the pressure responses in the lower aquifer, however, have yielded transmissivity values as shown in Tables II B-52 and II B-53. More complete permeability values are being calculated by the Leasee's reservoir simulation group.

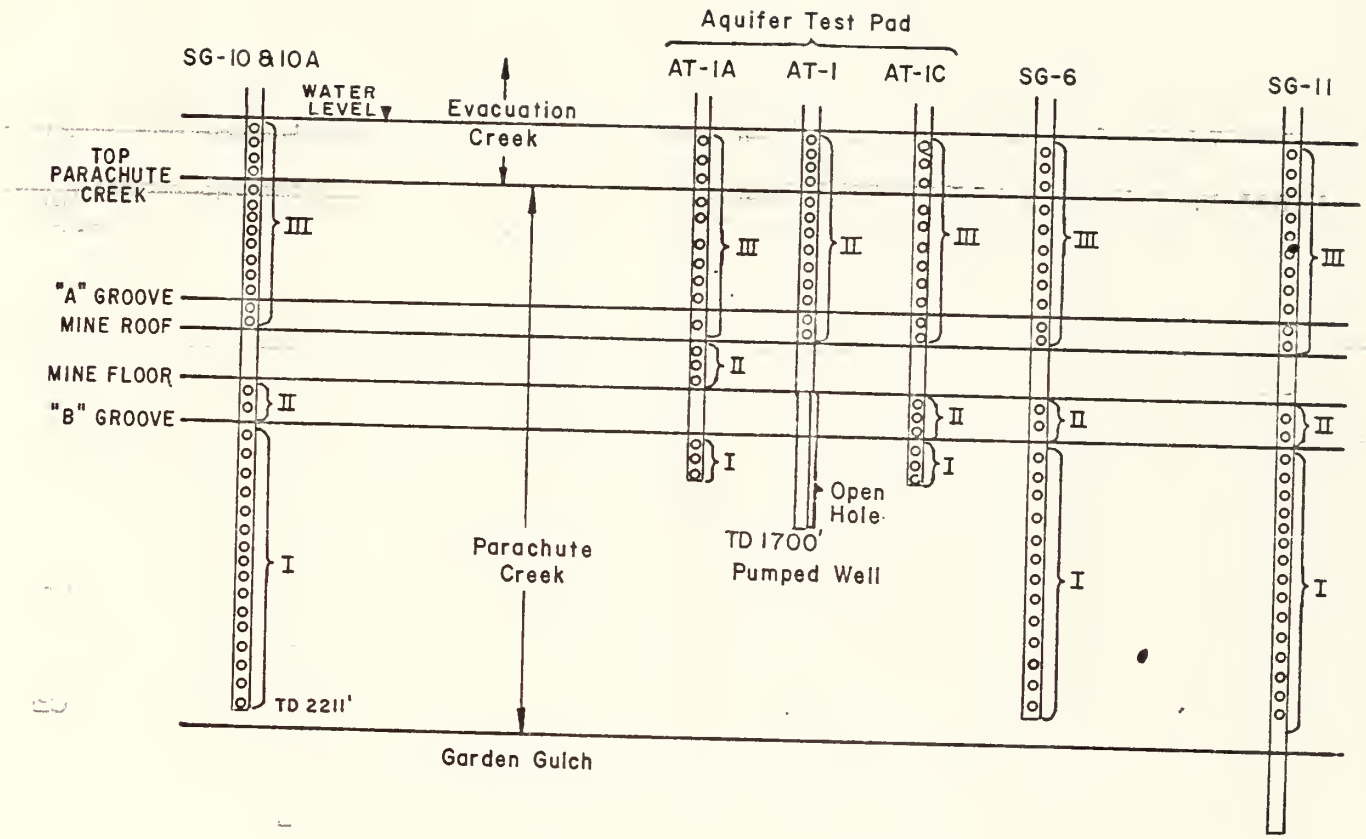


Figure
II B-14

Perforated Interval

II Tubing String Number

SCHEMATIC CROSS-SECTION
LOWER AQUIFER PUMP TEST
C-b TRACT, COLORADO

SCALE: None

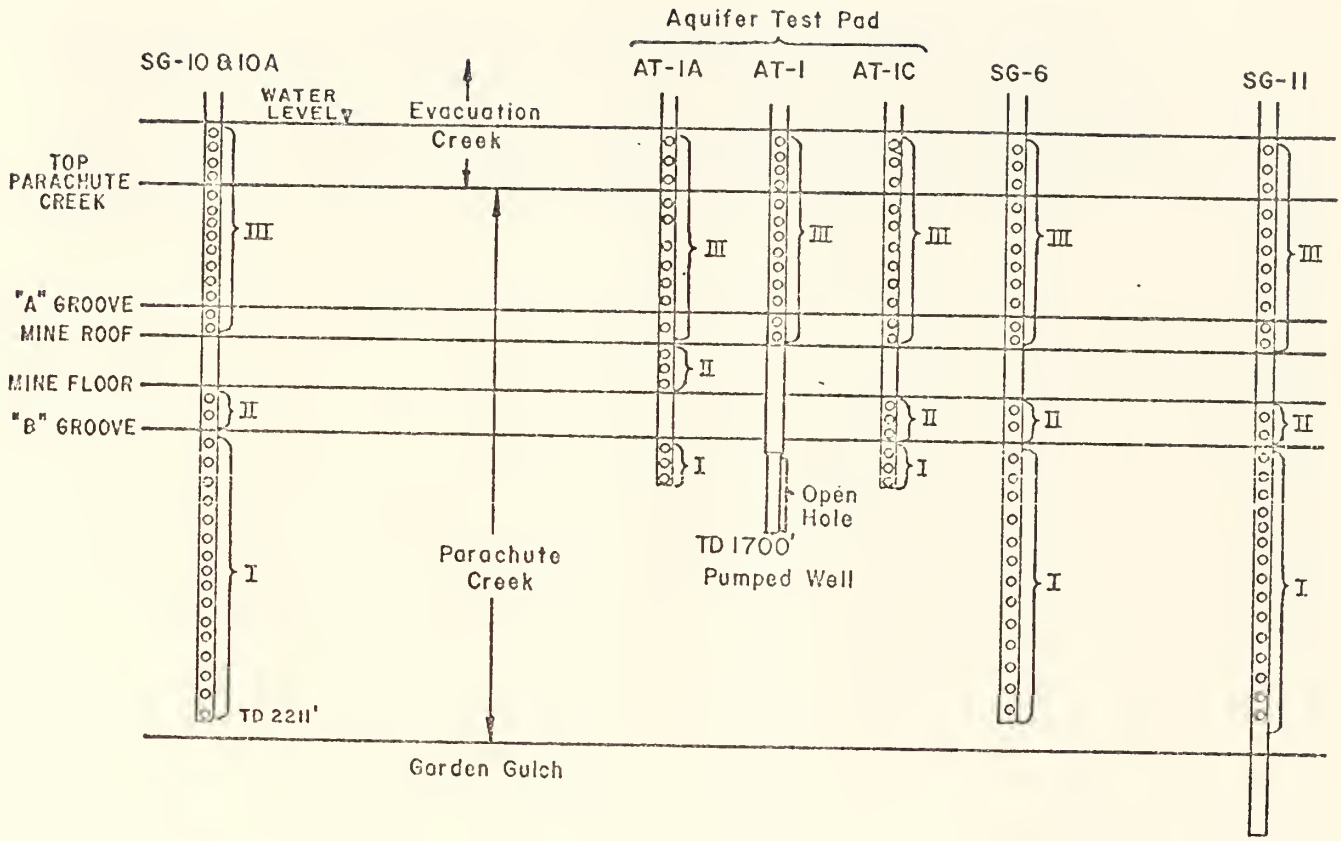


Figure II B-14

SCHEMATIC CROSS-SECTION
LOWER AQUIFER PUMP TEST
C-b TRACT, COLORADO

SCALE: None

Perforated Interval

II Tubing String Number

With respect to potential aquifer interconnection, it was observed that pressure gauges in the upper zone showed no response to the pumping in the lower zone, in spite of large drawdown of lower aquifer water levels during the pumping of AT-1. Water levels in the upper aquifer continued to recover throughout the lower zone test. This is an expected response, if the two aquifer systems are hydraulically separated by the Mahogany zone; water levels in the upper zone would be expected to recover or rise as a response to the termination of pumping of the upper aquifer.

Supplemental graphs have been provided which illustrate the manual data interpretation conducted to date (Pages II B-1088 through II B-1157). Pressure (psi) is plotted versus time for each of the well strings monitored during the lower zone tests. Additional data in the form of computer reduced water level responses and pressure responses is currently being generated and is not available for reporting.

TABLE II B-51
LOWER AQUIFER PUMP TEST

Sequence of Events

6-hour surge test drawdown (systems test) 2-5-75 (12 P.M.-6 P.M.)

surge test recovery 2-5-75 (6 P.M.) to 2-15-75 (5:20 P.M.)

Original start of drawdown 2-15-75 (5:20 P.M.) to 2-17-75 (12:45 P.M.)

(generator failure)

Recovery Period 2-17-75 (12:45 P.M.) to 2-21-75 (12:00 P.M.)

Initial drawdown 2-21-75 (12:00 P.M.) to 3-10-75 (10:00 A.M.)

17 days pumping

Initial recovery 3-10-75 (10:00 A.M.) to 3-18-75 (12:00 P.M.)

8 days shut in

Pulse test drawdown 3-18-75 (12:00 P.M.) to 3-26-75 (12:00 P.M.)

8 days pumping

Final recovery 3-26-75 (12:00 P.M.) to 4-15-75 (12:00 P.M.)

20 days shut in

Pulled pump and instruments 4-15-75

Set up limited data collection network in AT1-c, SG-6, SG-10, and SG-11 5-7-75 through 5-14-75 changed upper strings to Stevens digital recorders, lower and middle strings using pressure monitor on Sperry systems.

LOWER AQUIFER PUMP TEST

DRAWDOWN AND RECOVERY CURVES

TABLE II B-52

TRANSMISSIVITY AND STORAGE COEFFICIENT VALUES

LOWER AQUIFER PULSE TEST - DRAWDOWN PHASE

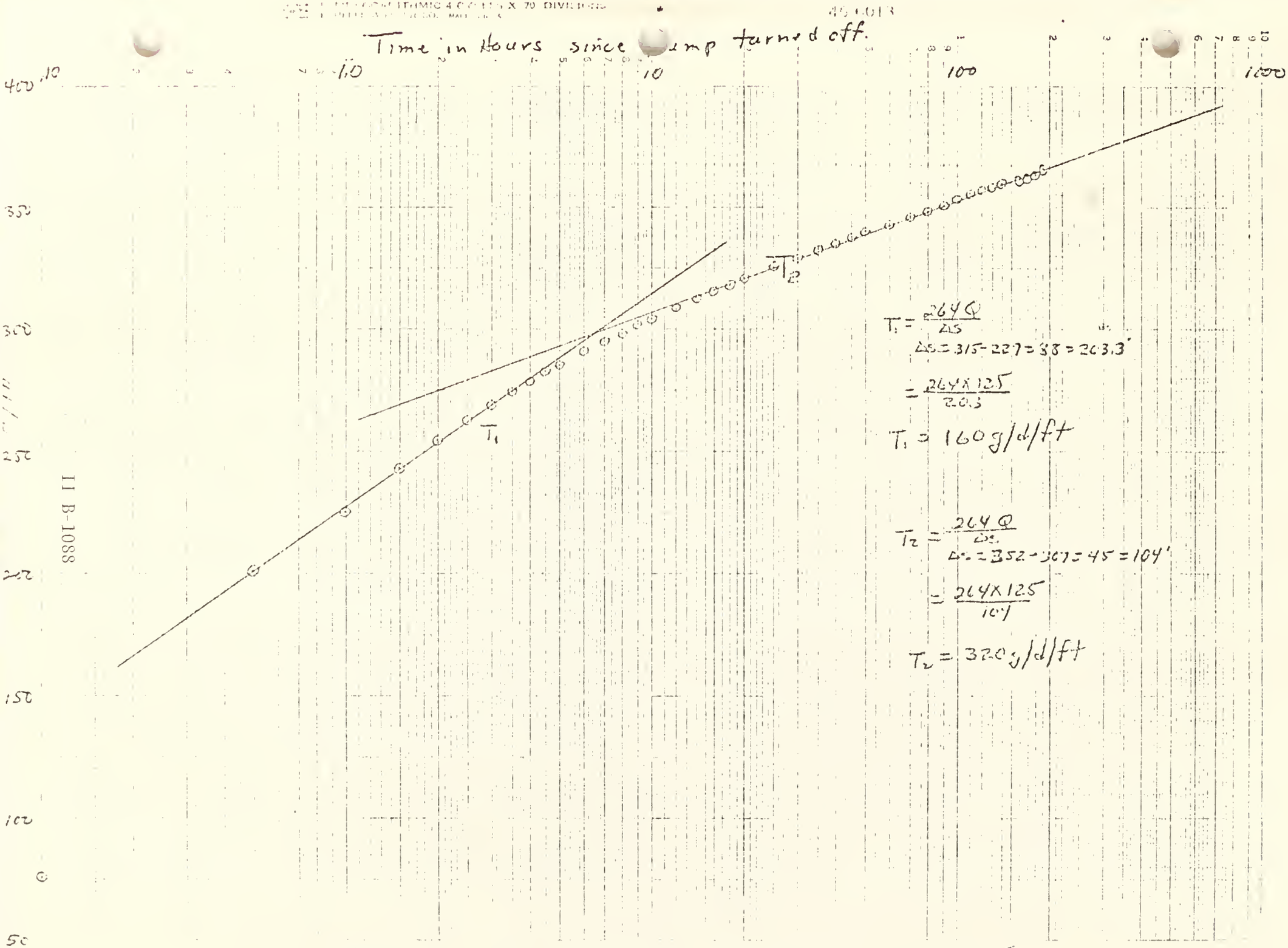
WELL NO.	DRAWDOWN COMPUTATIONS	Horizontal Permeability
AT-1	T = 359 gpd/ft. early stage T = 532 gpd/ft. middle stage T = 756 gpd/ft. final stage	153.5 millidarcys
AT-1A (String #1)	T = 465; S = 5x10-4	94.4 millidarcys
AT-1A (String #2)	Interpretative technique is not applicable	
AT-1C (String #1)	T = 219; S = 5x10-5 early stage Instrument drift during final stage	
AT-1C (String #2)	T = 316; S = 2x10-5 early stage T = 513; S = 6x10-7 final stage	104.2 millidarcys
AT-1D (String #2)	T = 271; S = 3x10-5 early stage T = 327; S = 7x10-7 final stage	66.4 millidarcys
SG-6 (String #1	Slight downward response	
SG-6 (String #2)	T = 442; S = 8x10-5 final stage	89.7 millidarcys
SG-10 (String #1)	T = 1468; S = 2x10-4 T - 811; S - 1x10-4	164.6 millidarcys
SG- (String #2)	No response	
SG-11 (String #1)	No response	
SG-11 (String #2)	Overall downward trend	

TABLE II B-53

TRANSMISSIVITY and STORAGE COEFFICIENT VALUES

LOWER AQUIFER PUMP TEST

Well No.	Initial Drawdown	Initial Recovery
AT #1	T = 310 g/d/ft. Initial T = 460 Secondary T = 380 Tertiary	T = 160 g/d/ft. Initial T = 320 Secondary
AT #1A (String #1)	T = 441; S = 3.11x10-4 T = 338; S = 4.56x10-4	T = 435; S = 5.64x10-4 T = 335; S = 8.11x10-4
AT #1A (String #2)	No Valid Response	No Valid Response
AT #1C (String #1)	T = 129; S = 1.52x10-4 T = 260; S = 2.24x10-5	T = 1125; S = 1.80x10-4 T = 255; S = 3.22x10-5
(String #2)	T = 173; S = 5.82x10-5 T = 275; S = 2.04x10-5 T = 376; S = 3.77x10-6	T = 157; S = 9.44x10-5 T = 340; S = 1.98x10-5
AT #1D (String #1)	T = 143; S = 1.08x10-4 T = 348; S = 8.63x10-6	T = 136; S = 1.18x10-4 T = 325; S = 2.14x10-5
SG - 6 (String #1)	T = 1430; S = 4.52x10-4 T = 620; S = 3.87x10-4	T = 2800; S = 7.38x10-4
(String #2)	T = 1520; S = 6.86x10-5 T = 574; S = 5.62x10-5 T = 305; S = 6.66x10-5	T = 400; S = 7.53x10-5
SG - 10 (String #1)	T = 490; S = 6.06x10-5	T = 950; S = 1.13x10-4 T = 846; S = 1.11x10-4
(String #2)	No Response	Very Slight Downward Response
SG - 11 (String #1)	No Response	No Response
(String #2)	T = 1065; S = 1.69x10-3	No Recovery-Downward Response



$T_1 = \frac{264\,Q}{\Delta s}$

$\Delta s = 315 - 227 = 88 = 26.3'$

$= \frac{264 \times 12.5}{26.3}$

$T_1 = 160\ g/d/ft$

$T_2 = \frac{264\,Q}{\Delta s}$

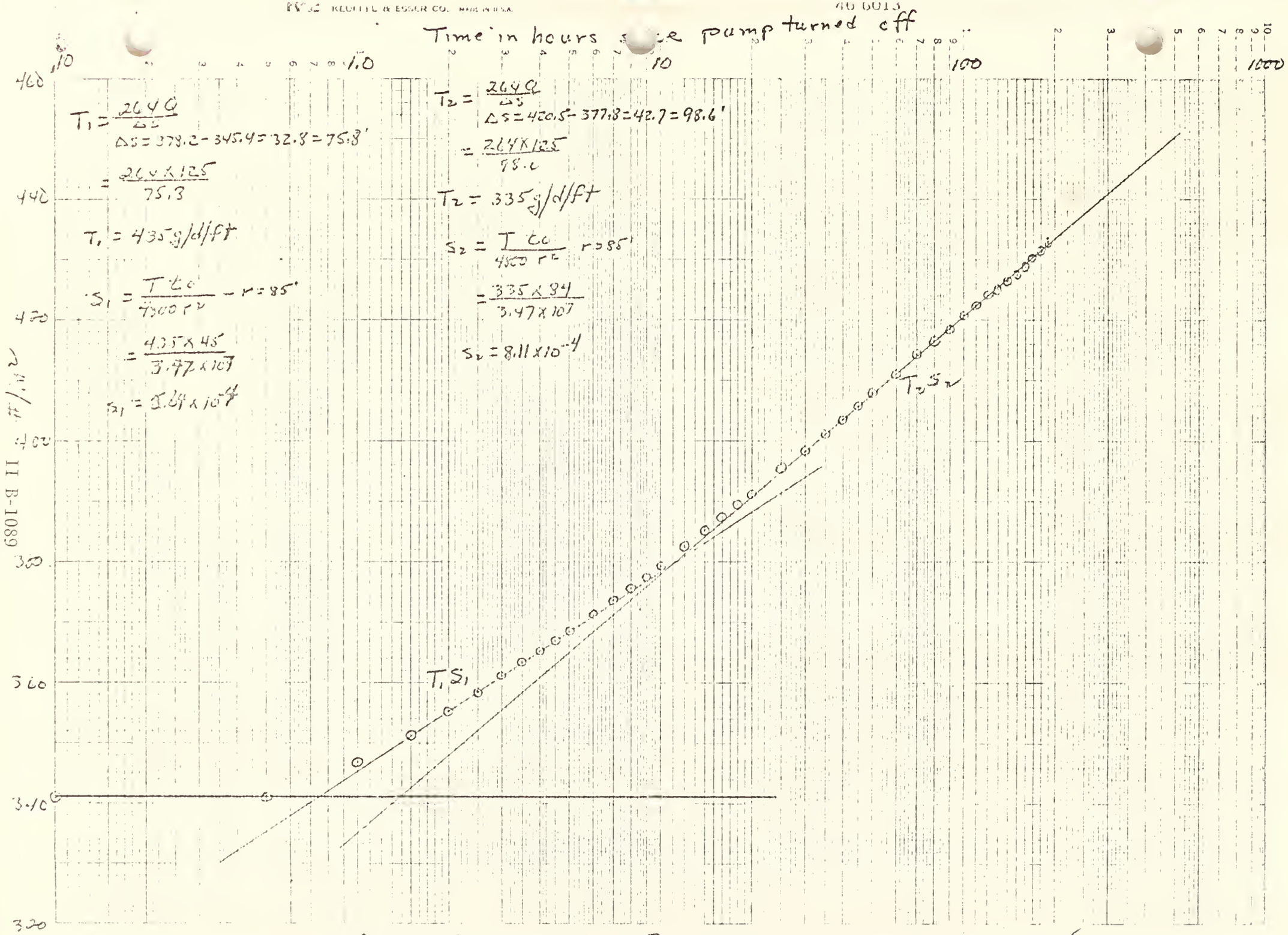
$\Delta s = 352 - 307 = 45 = 10.4'$

$= \frac{264 \times 12.5}{10.4}$

$T_2 = 320\ g/d/ft$

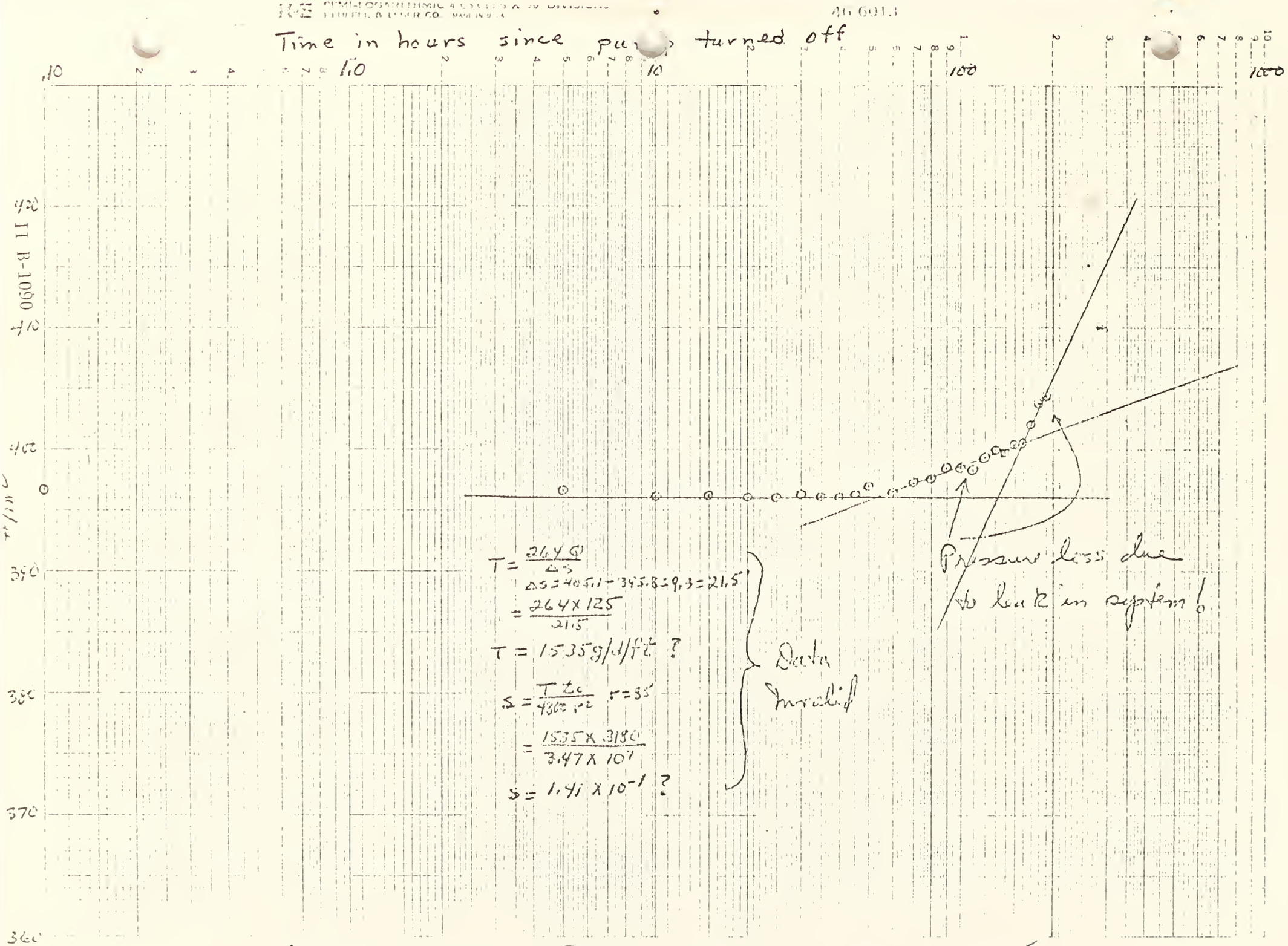
AT #1 Recovery Test 3-10-75 — 3-18-75

KEUFFEL & ESSER CO. MADE IN U.S.A. 46 6013

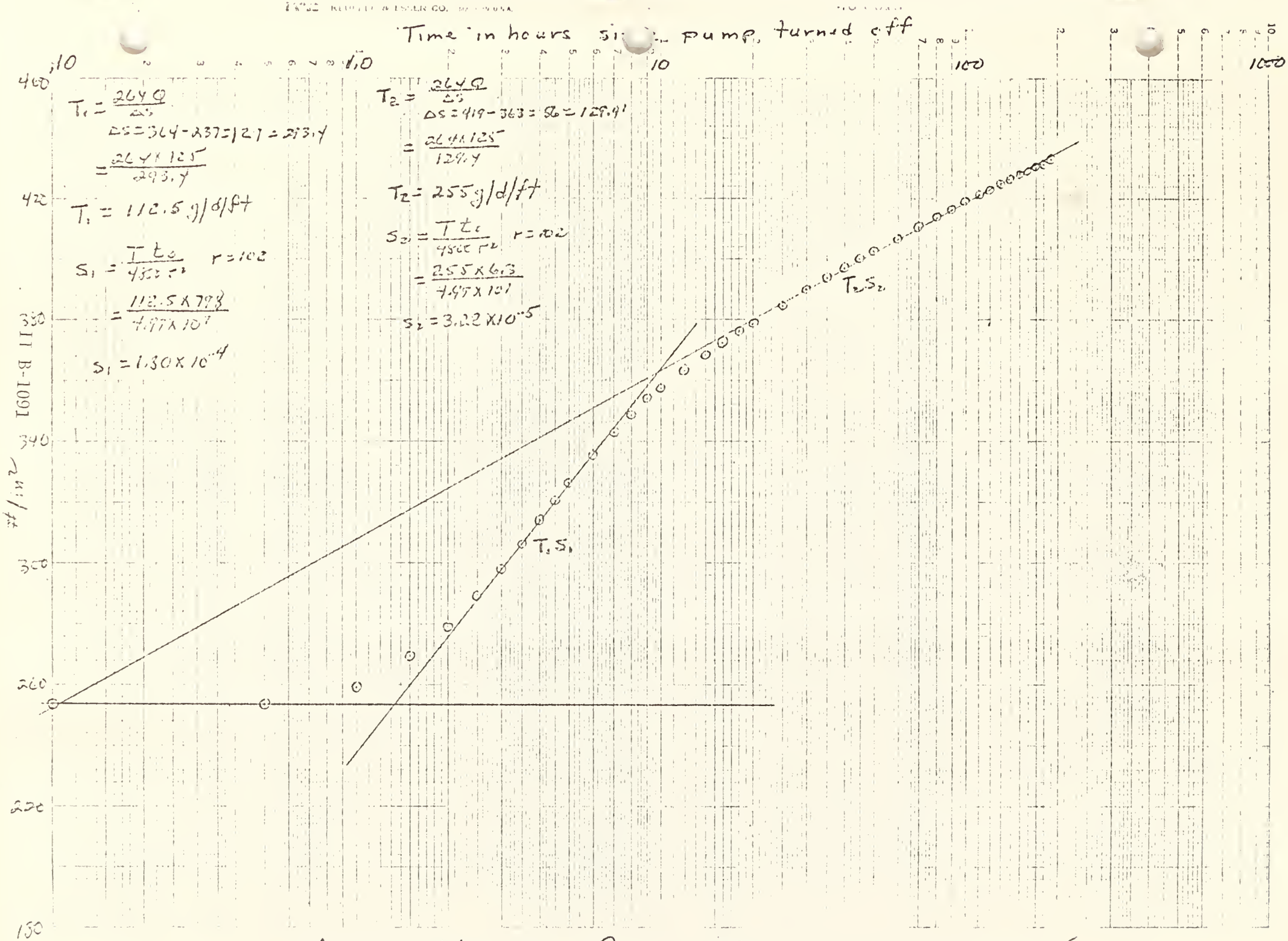


AT#1A - String #1 Recovery Test 3-10-75 — 3-18-75

II B-1089



AT#1A - String #2 - Recovery Test 3-10-75 — 3-18-75



AT-1C String #1 Recovery Test 3-10-75 — 3-18-75

SEMI-LOGARITHMIC 4 CYCLES X 10 DIVS.
KEUFFEL & ESSER CO. MADE IN U.S.A.

Time in hours since pump turned off

$T_1 = \frac{264Q}{\Delta s}$

$\Delta s = 336 - 245 = 91 = 210.2$

$= \frac{264 \times 125}{210.2}$

$T_1 = 157\ g/d/ft$

$S_1 = \frac{T t_0}{4500 r^2} = 102$

$= \frac{157 \times 30}{4.44 \times 10^7}$

$S_1 = 9.44 \times 10^{-5}$

$T_2 = \frac{264Q}{\Delta s}$

$\Delta s = 385 - 343 = 42 = 97.0$

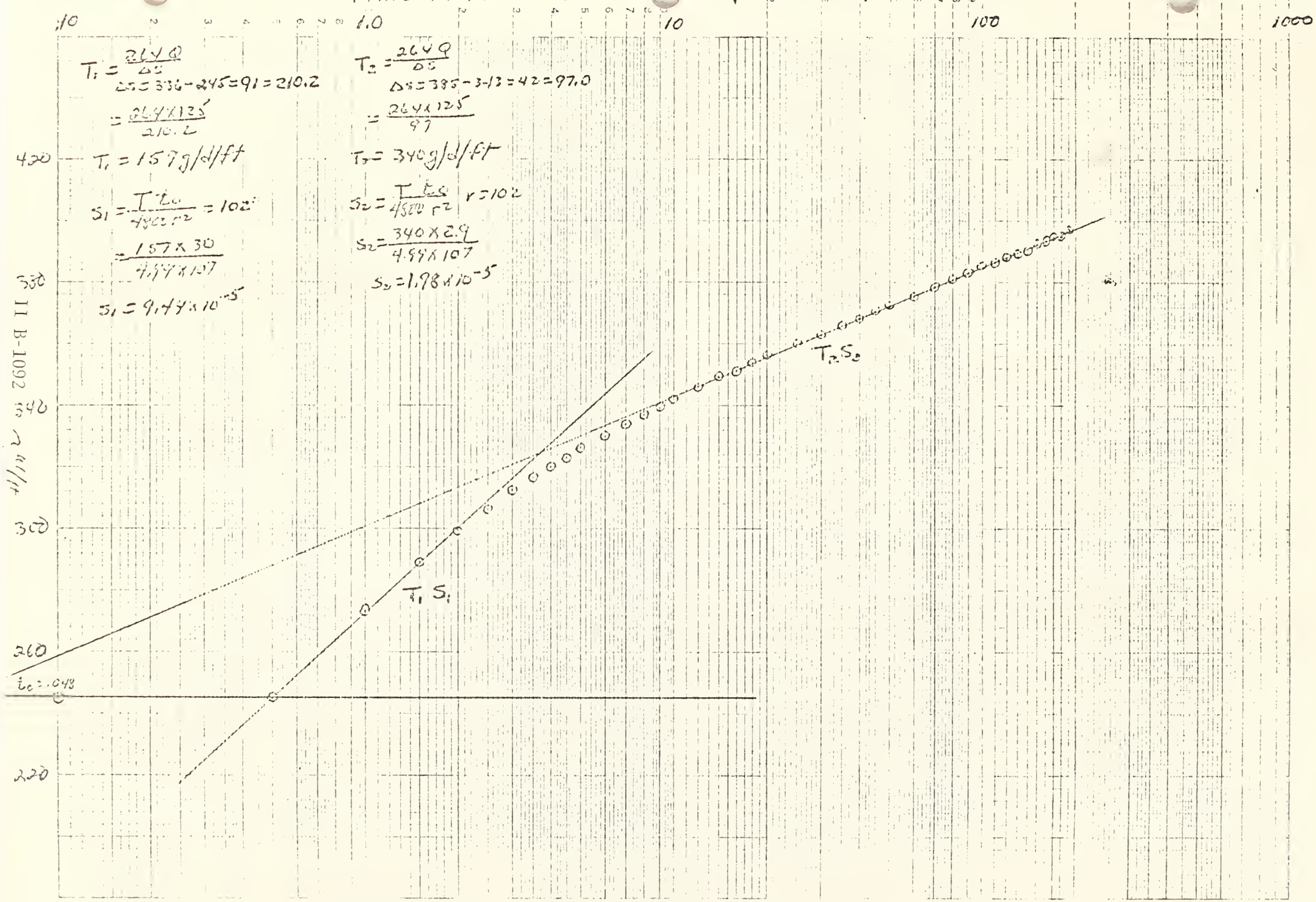
$= \frac{264 \times 125}{97}$

$T_2 = 340\ g/d/ft$

$S_2 = \frac{T t_0}{4500 r^2}$ $r = 102$

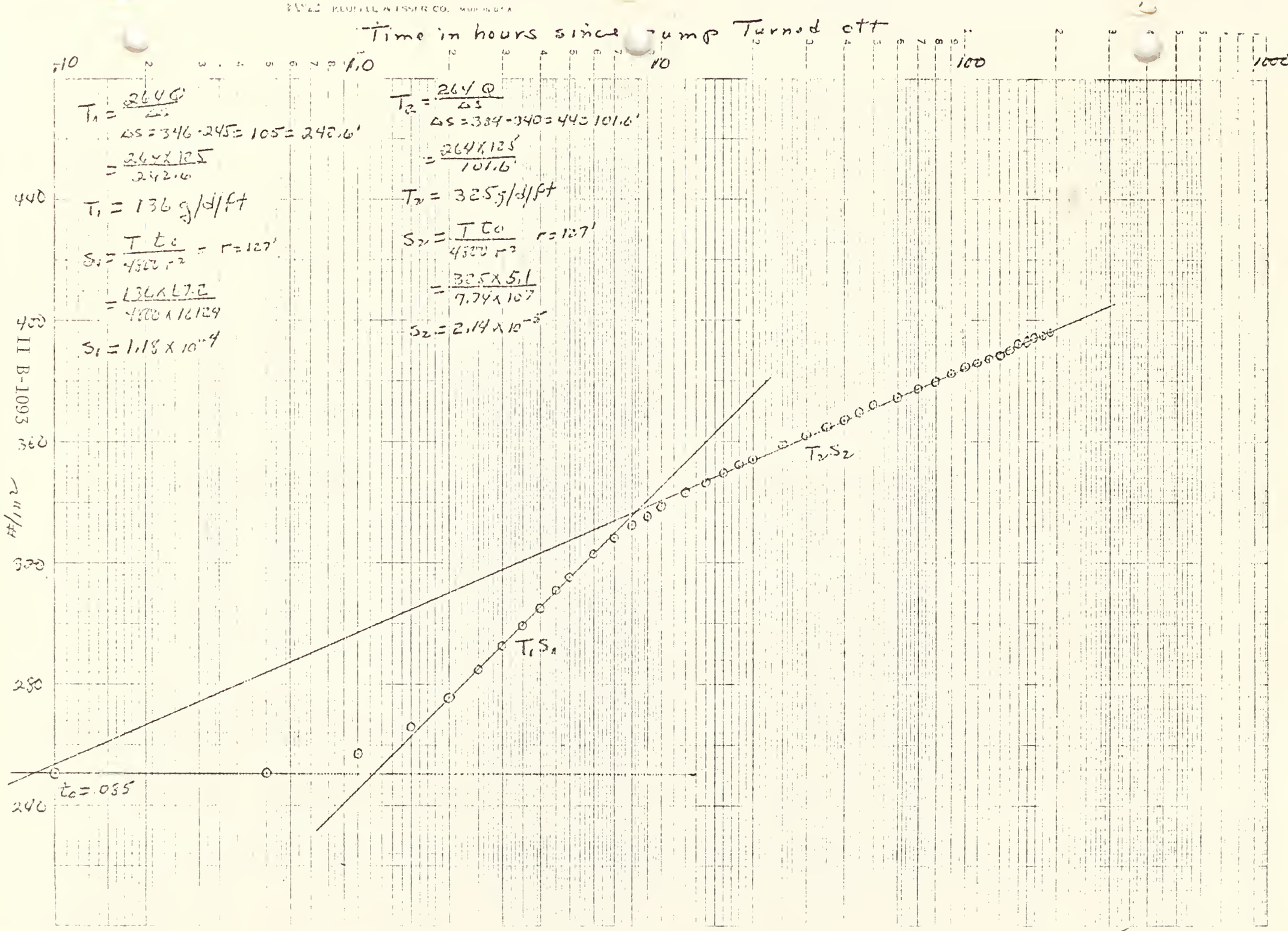
$S_2 = \frac{340 \times 2.9}{4.44 \times 10^7}$

$S_2 = 1.98 \times 10^{-5}$



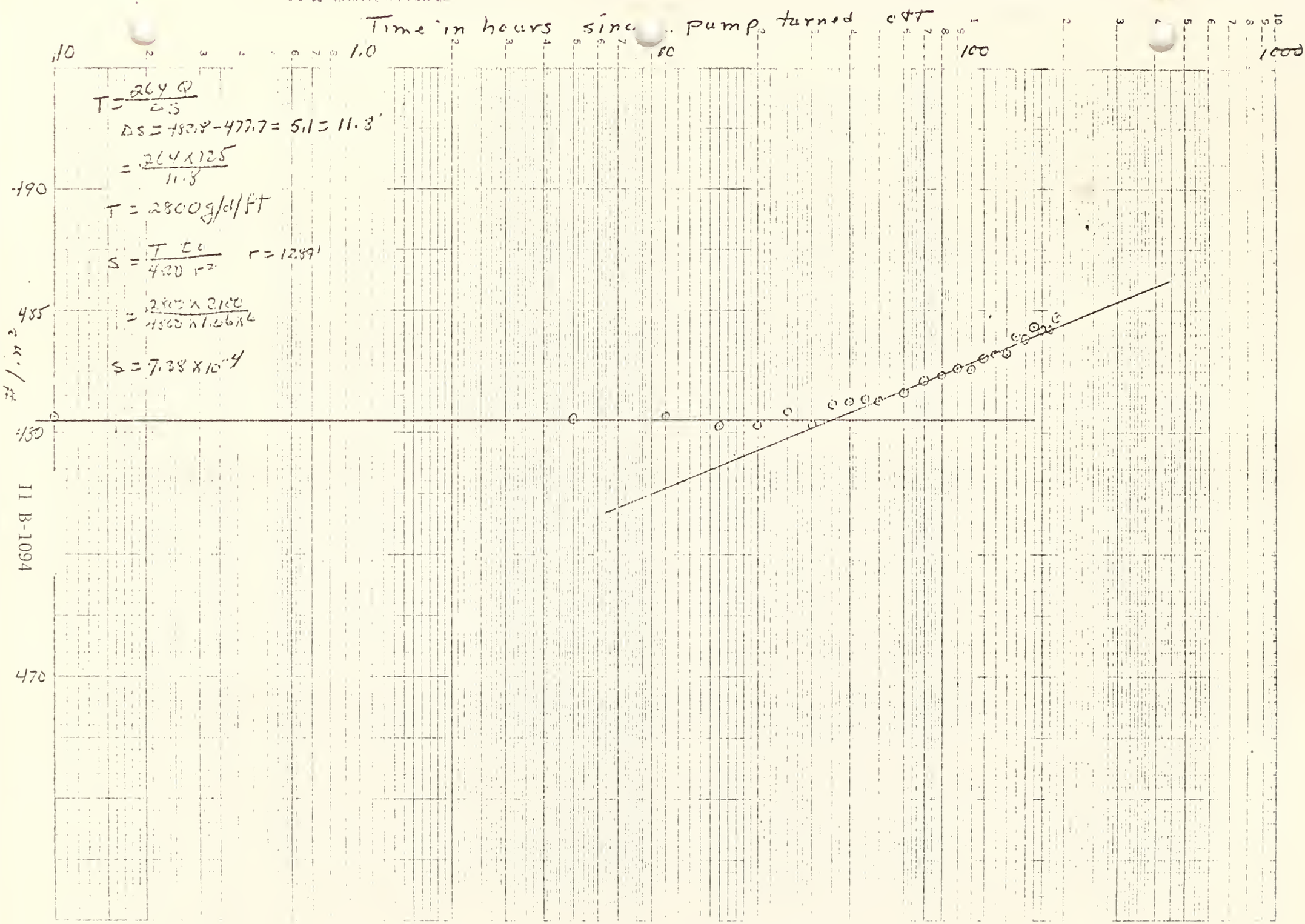
II B-1092

AT#1C String #2 Recovery Test 3-10-75 — 3-18-75

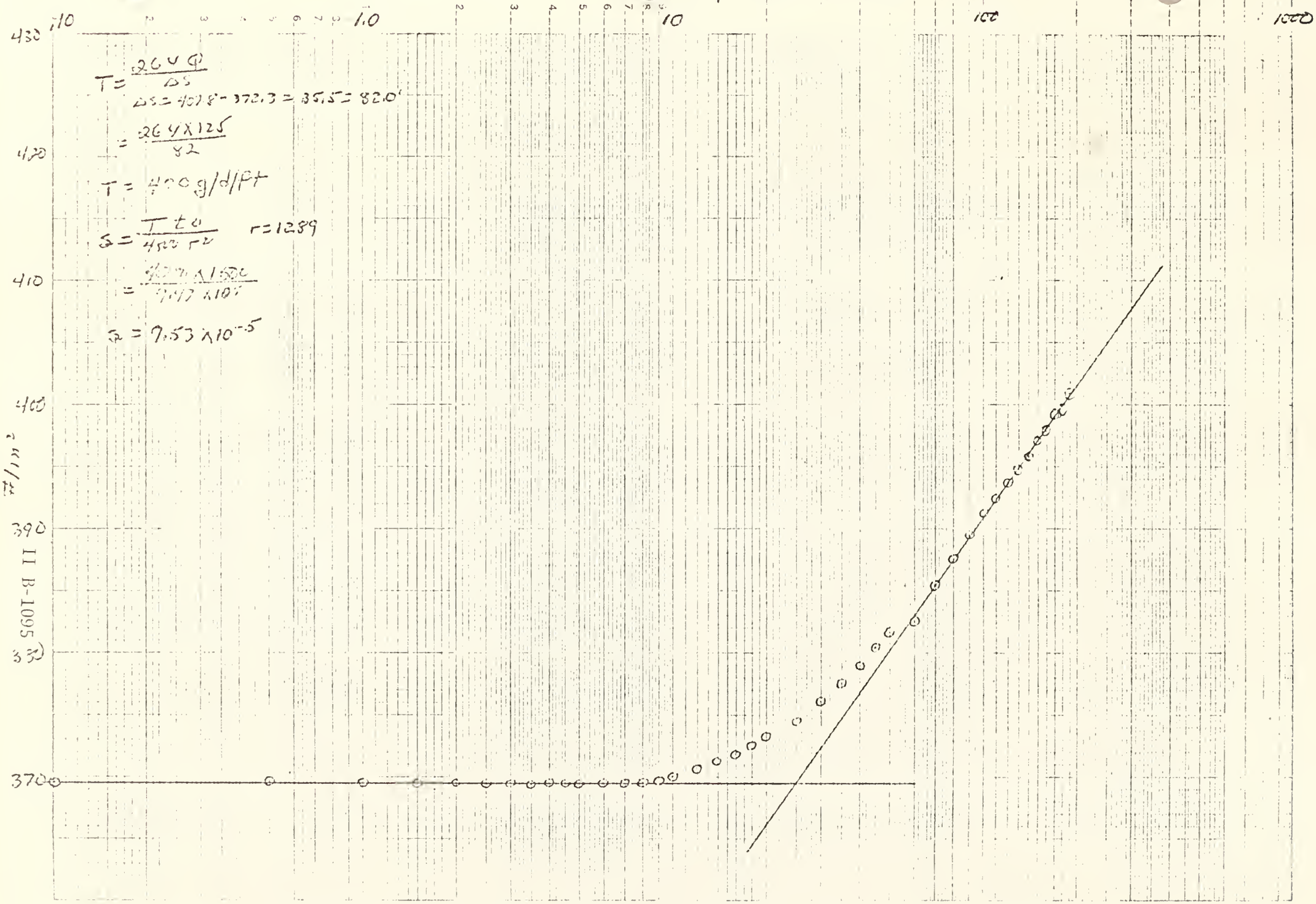


AT#1D - String #1 Recovery Test 3-10-75 — 3-18-75

II B-1093



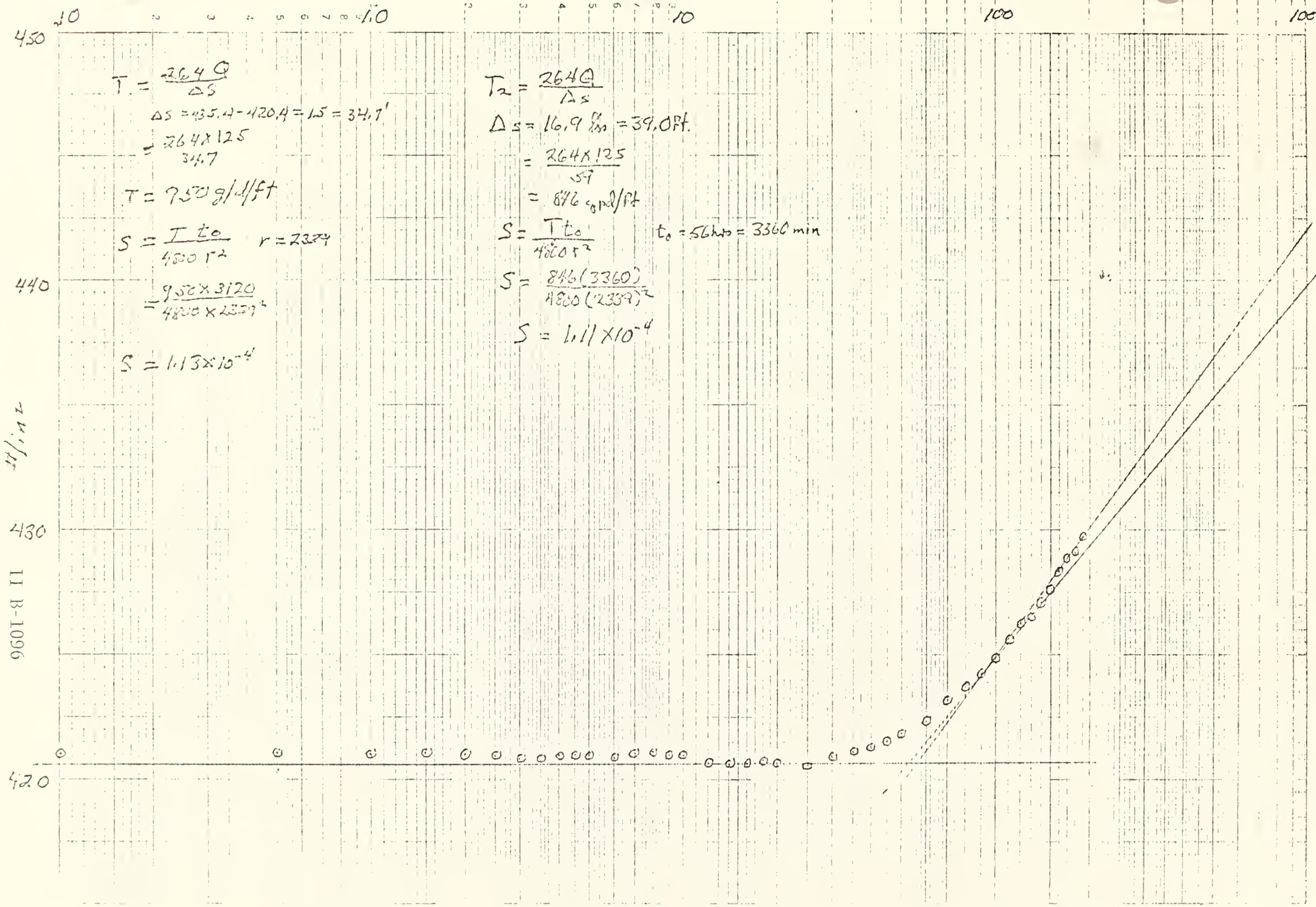
SG-6 #1 String Recovery Test 3-10-75 – 3-18-75



SG-6 String #2 Recovery Test 3-10-75 — 3-18-75

KEUFFEL & ESSER CO. MADE IN U.S.A.

Time in hours since pump turned off



$T = \frac{264Q}{\Delta s}$

$\Delta s = 435.4 - 420.4 = 15 = 34.1'$

$= \frac{264 \times 125}{34.7}$

$T = 950$ gal/d/ft

$S = \frac{T t_0}{480 r^2}$ $r = 2339$

$= \frac{950 \times 3120}{480 \times 2339^2}$

$S = 1.13 \times 10^{-4}$

$T_2 = \frac{264Q}{\Delta s}$

$\Delta s = 16.9$ ft $= 39.0$ ft.

$= \frac{264 \times 125}{39}$

$= 846$ gpd/ft

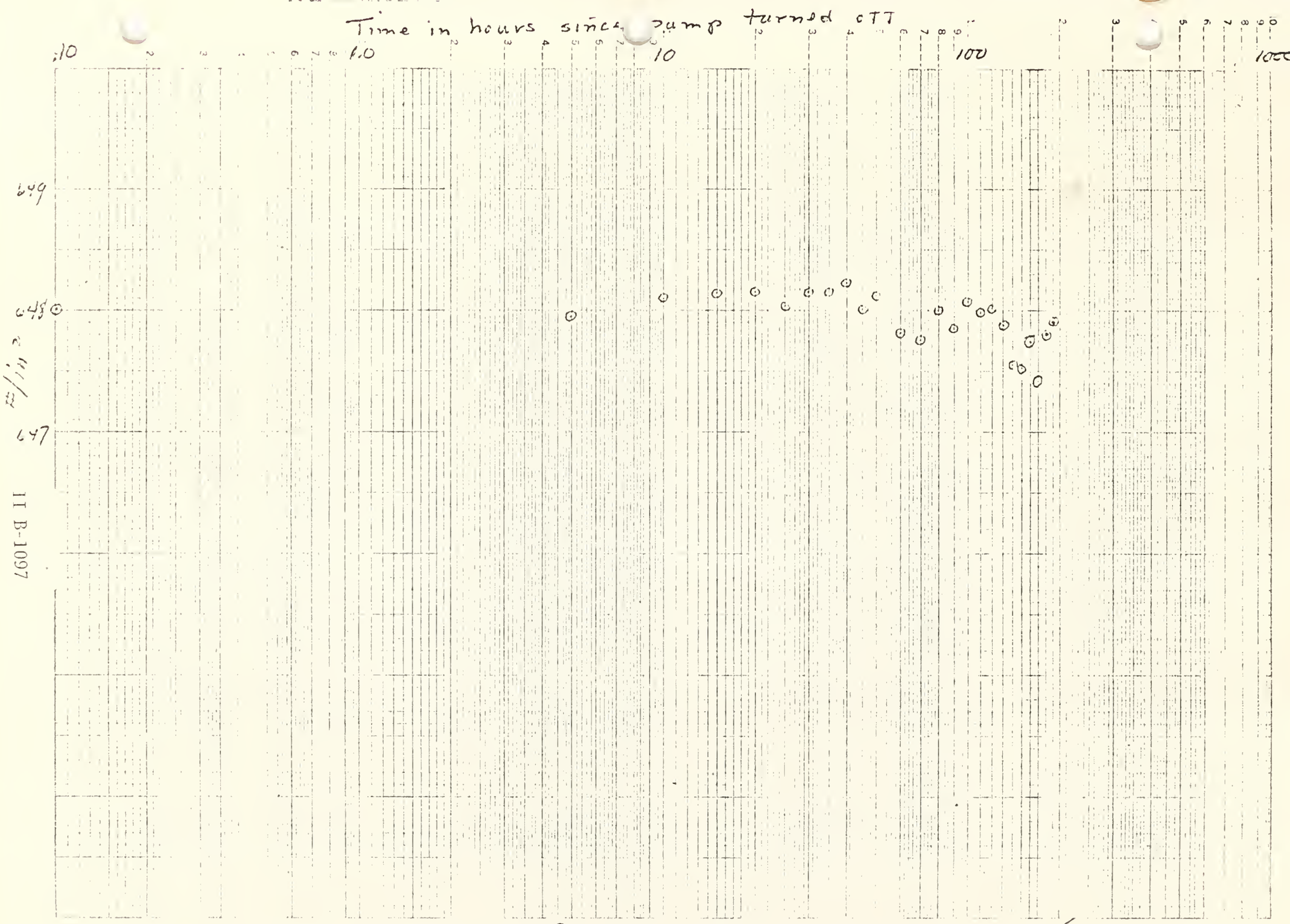
$S = \frac{T t_0}{480 r^2}$ $t_0 = 56$ hrs $= 3360$ min

$S = \frac{846(3360)}{480(2339)^2}$

$S = 1.11 \times 10^{-4}$

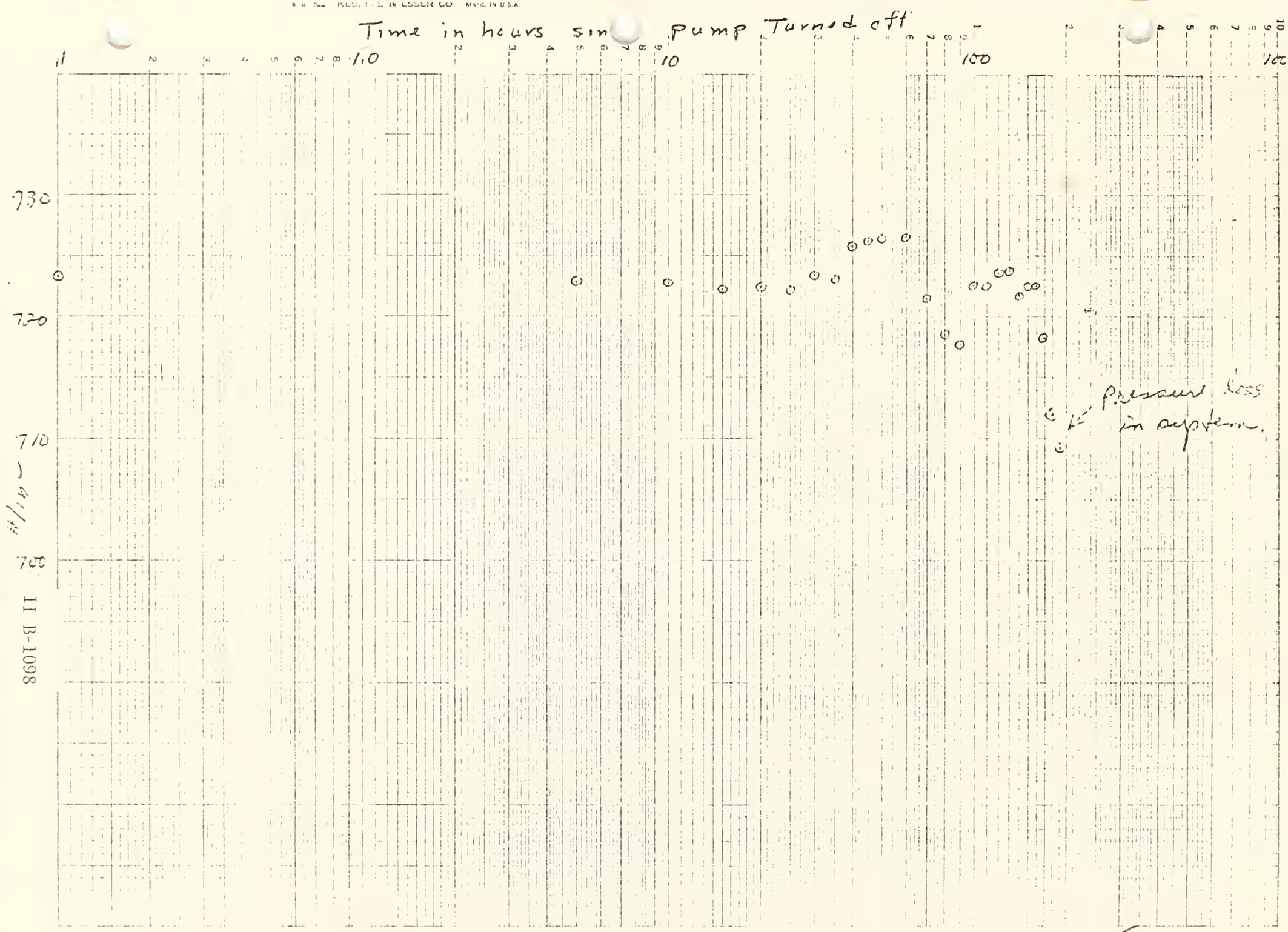
SG-10 String #1 Recovery Test 3-10-75 – 3-18-75

II B-1096



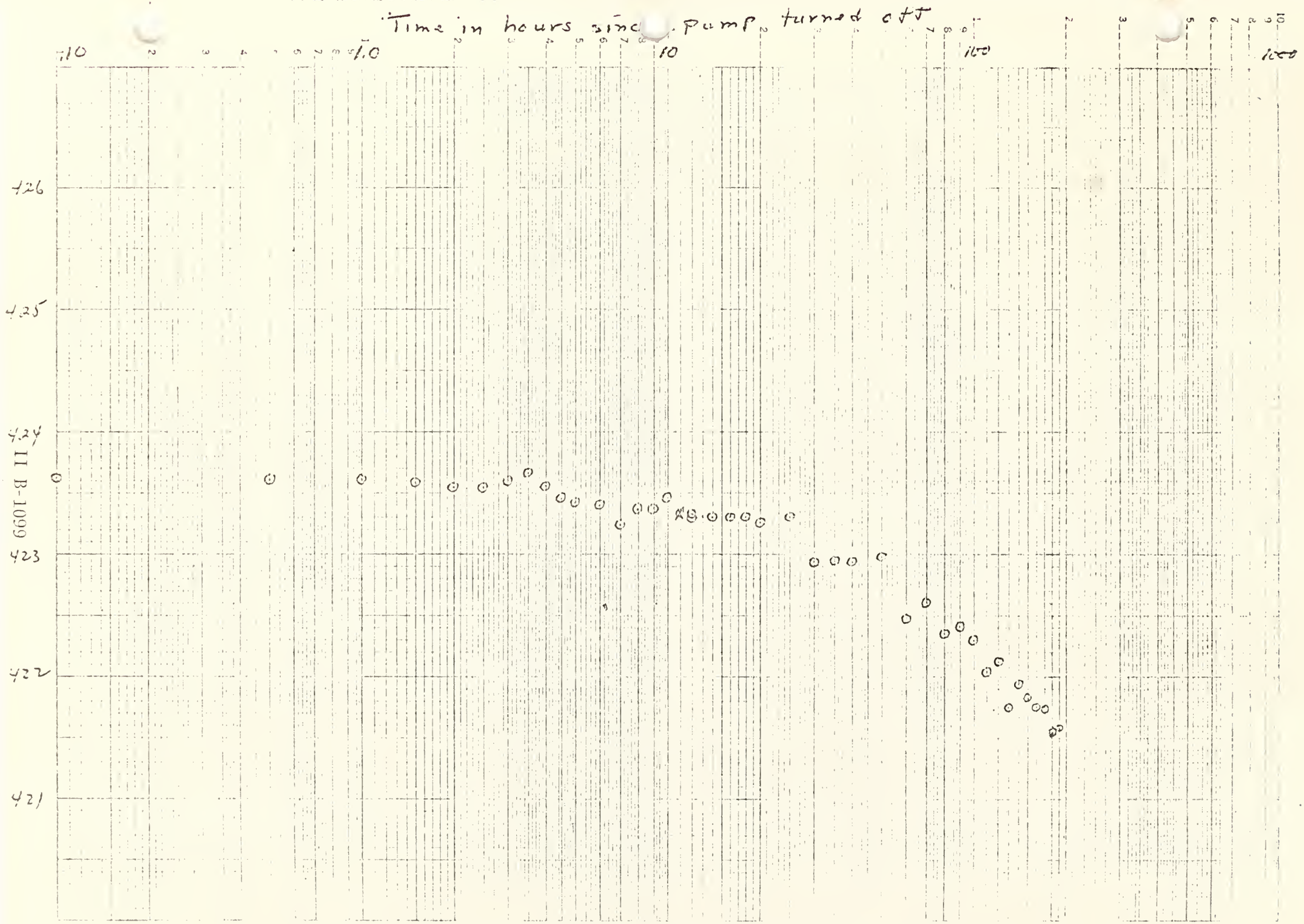
SG-10 String #2 Recovery Test 3-10-75 — 3-18-75

KEUFFEL & ESSER CO. MADE IN U.S.A.

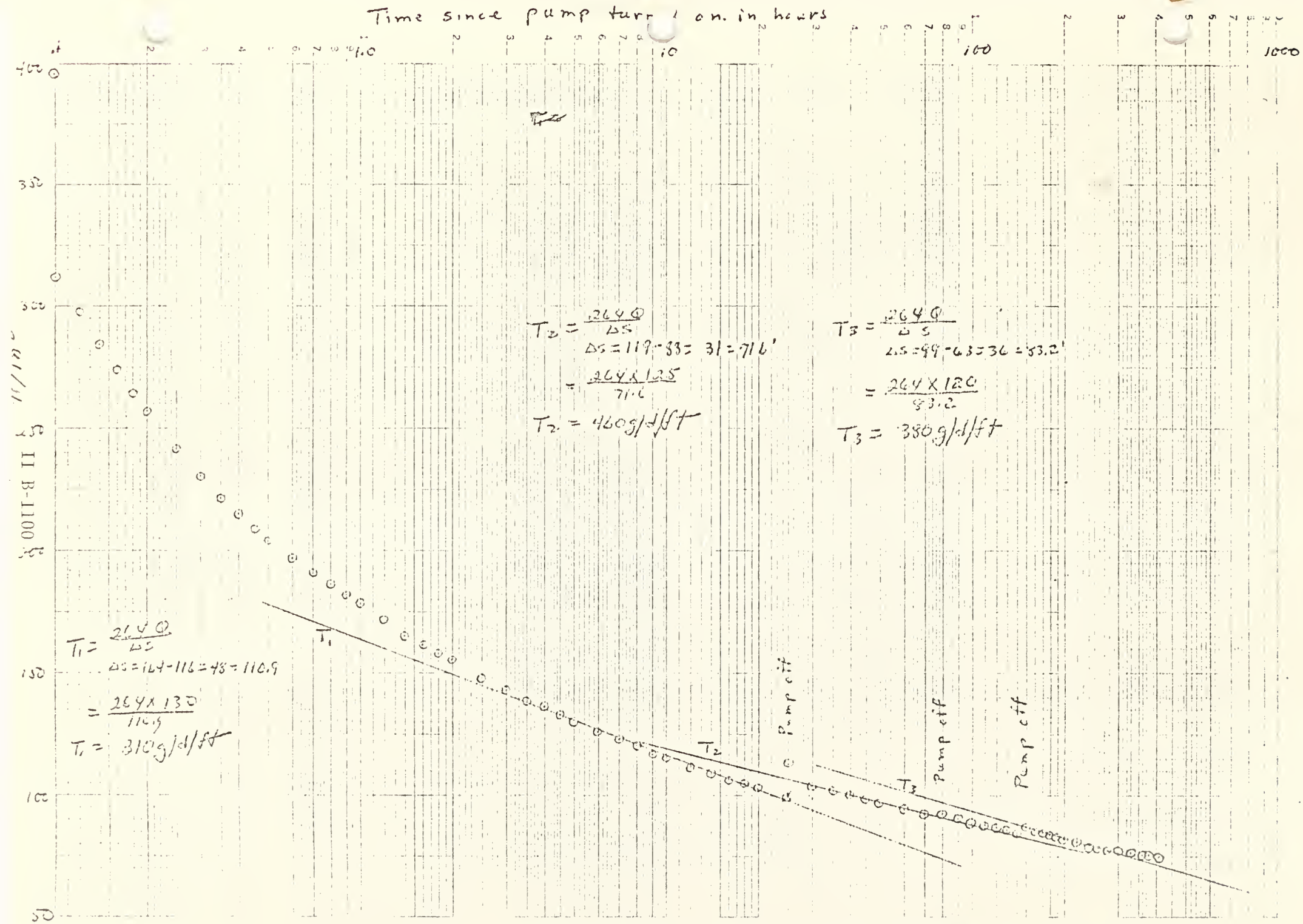


II B-1098

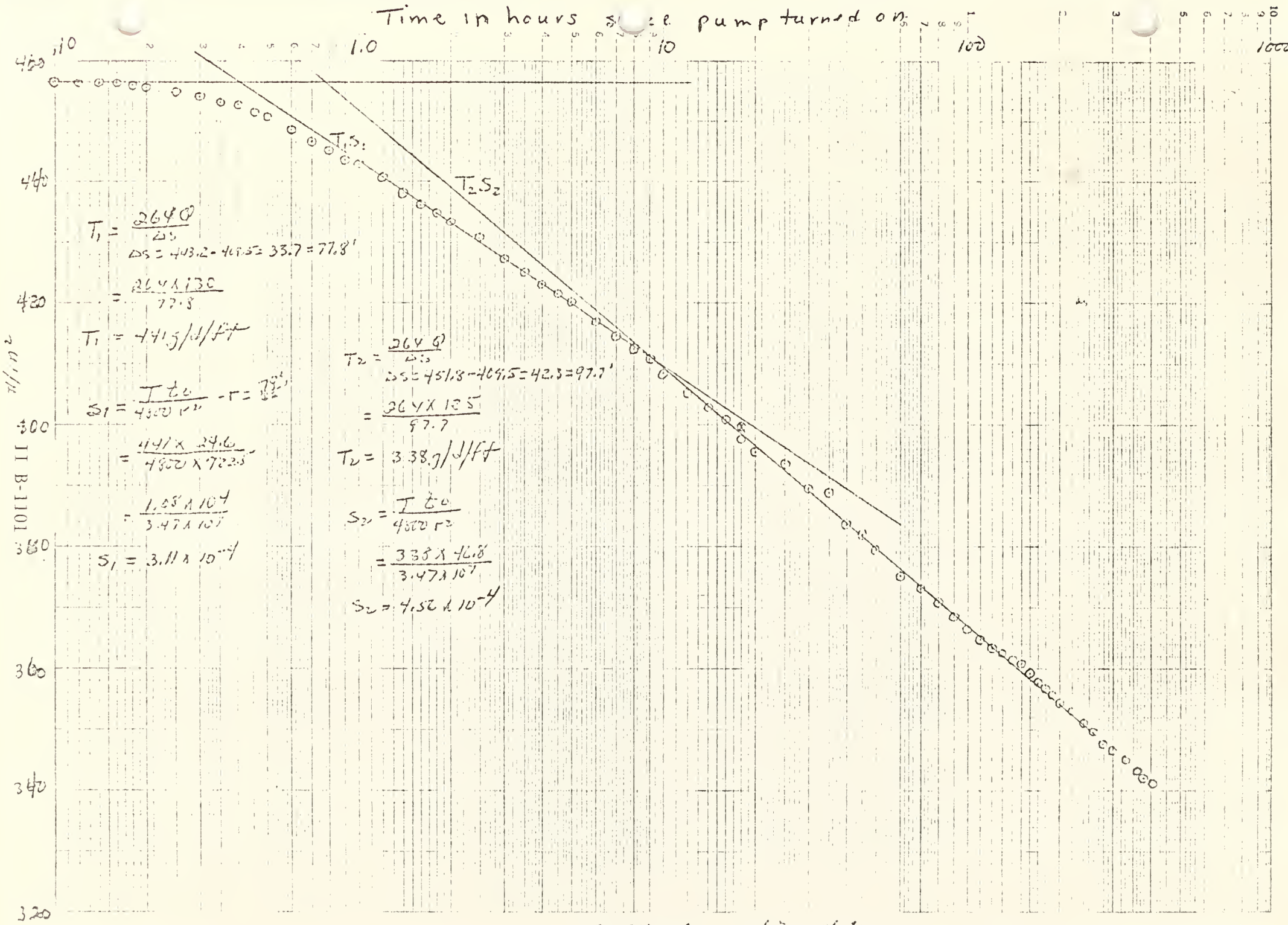
SG-11 String #1 Recovery Test 3-10-75 — 3-18-75



SG-11 String #2 Recovery Test 3-10-75



AT #1 - Draw down test. 2-28-75 - 3-10-75



AT #1 A - String #1 Drawdown Test - 2-21-75 — 3-10-75

II B-1101

SEMI LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 6013

Time in hours since pump turned on.

.10 1.0 10 100 1000

430
420
410
400
390
380
370
360

Rising pressure head in system
Recharged system

$\Delta s = 400.7 - 393.4 = 8.3 = 21.5'$

$T = \frac{264Q}{\Delta s}$

$= \frac{264 \times 135}{21.5}$

$T = 1535$ gal/ft ?

$S = \frac{T t_0}{4000 r^2}$ $r = 85'$

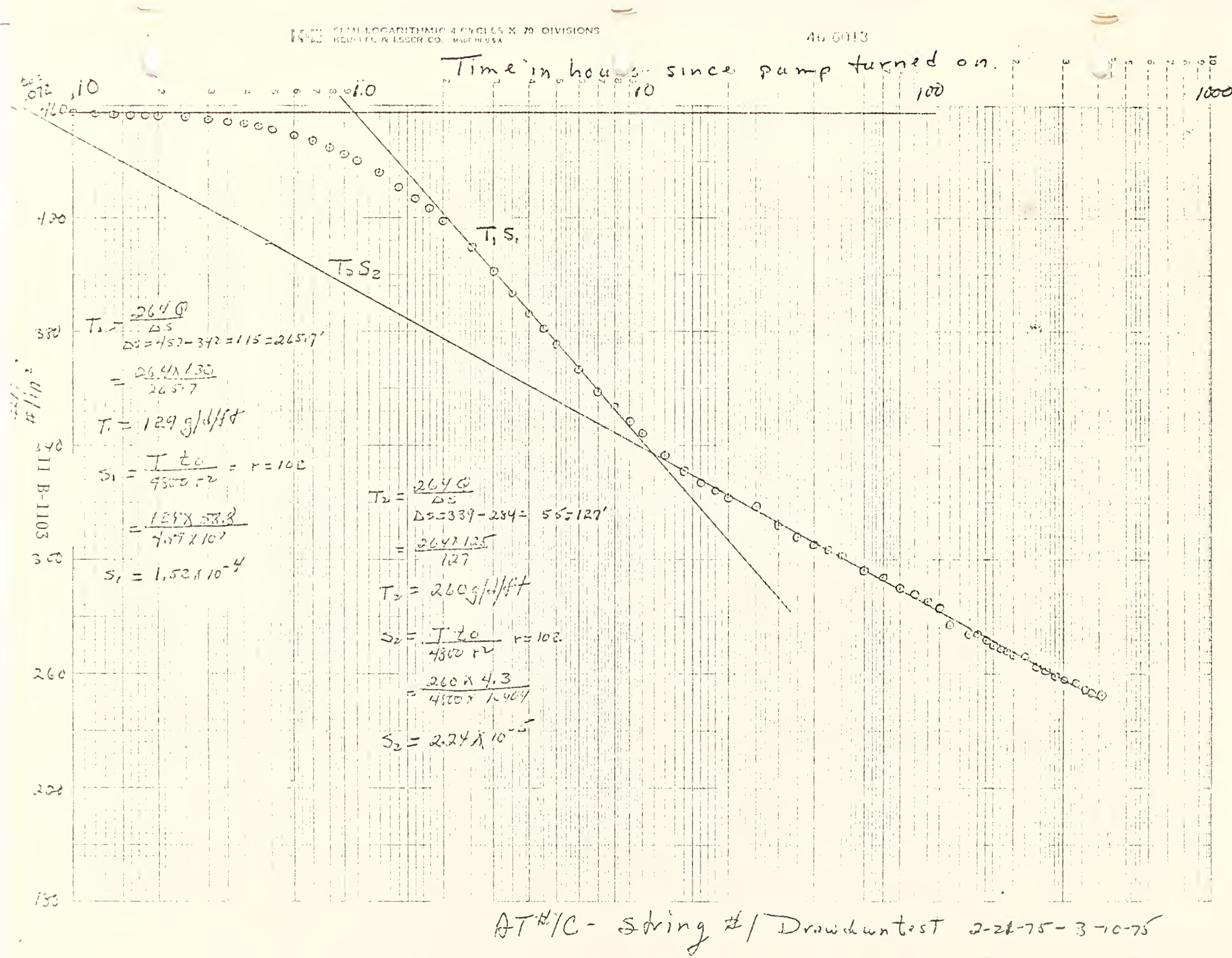
$= \frac{1535 \times 14400}{4000 \times 7225}$

$S = 6.37 \times 10^{-1}$?

Data invalid - leaks in system

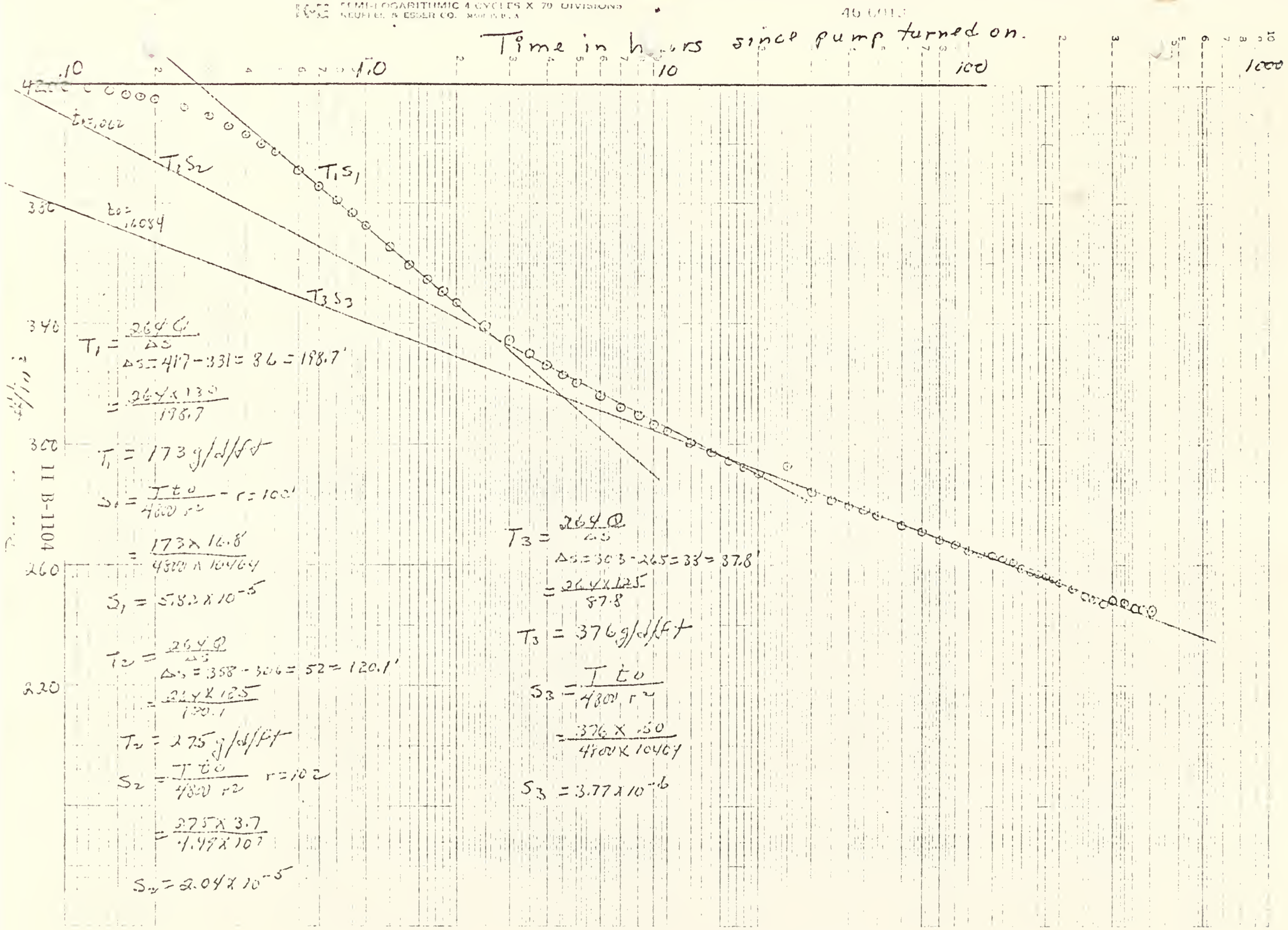
AT #1A - Stiling #2 Drawdown Test 2-28-75 — 3-10-75

II B-1102



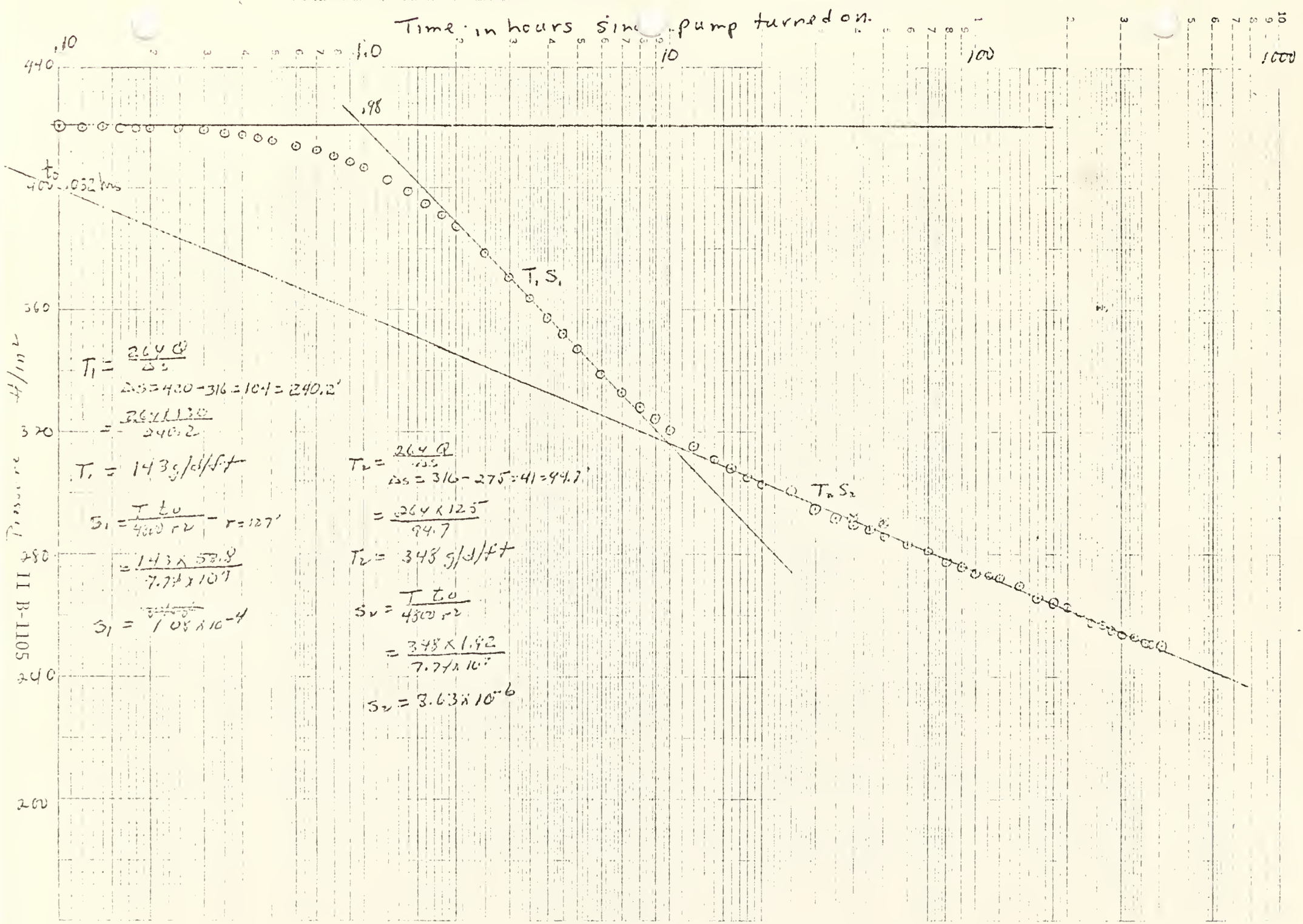
SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 6013
Time in hours since pump turned on.
.072
.10
1.0
10
100
1000
460
420
380
340
300
260
220
180
#/in²
T₁ S₁
T₂ S₂
T₁ = 264 Q / Δs
Δs = 457 − 342 = 115 = 265.7'
= 264 × 130 / 265.7
T₁ = 129 g/d/ft
S₁ = T t₀ / 4800 r² = r = 102
= 129 × 58.8 / 4.59 × 10⁷
S₁ = 1.52 × 10⁻⁴
T₂ = 264 Q / Δs
Δs = 339 − 284 = 55 = 127'
= 264 × 125 / 127
T₂ = 260 g/d/ft
S₂ = T t₀ / 4800 r² r = 102
= 260 × 4.3 / 4800 × 1.404
S₂ = 2.24 × 10⁻⁵
AT #1C - String #1 Drawdown test 2-21-75 - 3-10-75

II B-1103



AT #1C - String #2 Drawdown Test 2-28-75-3-10-75

SEMI-LOGARITHMIC 1 CYCLE X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 6013

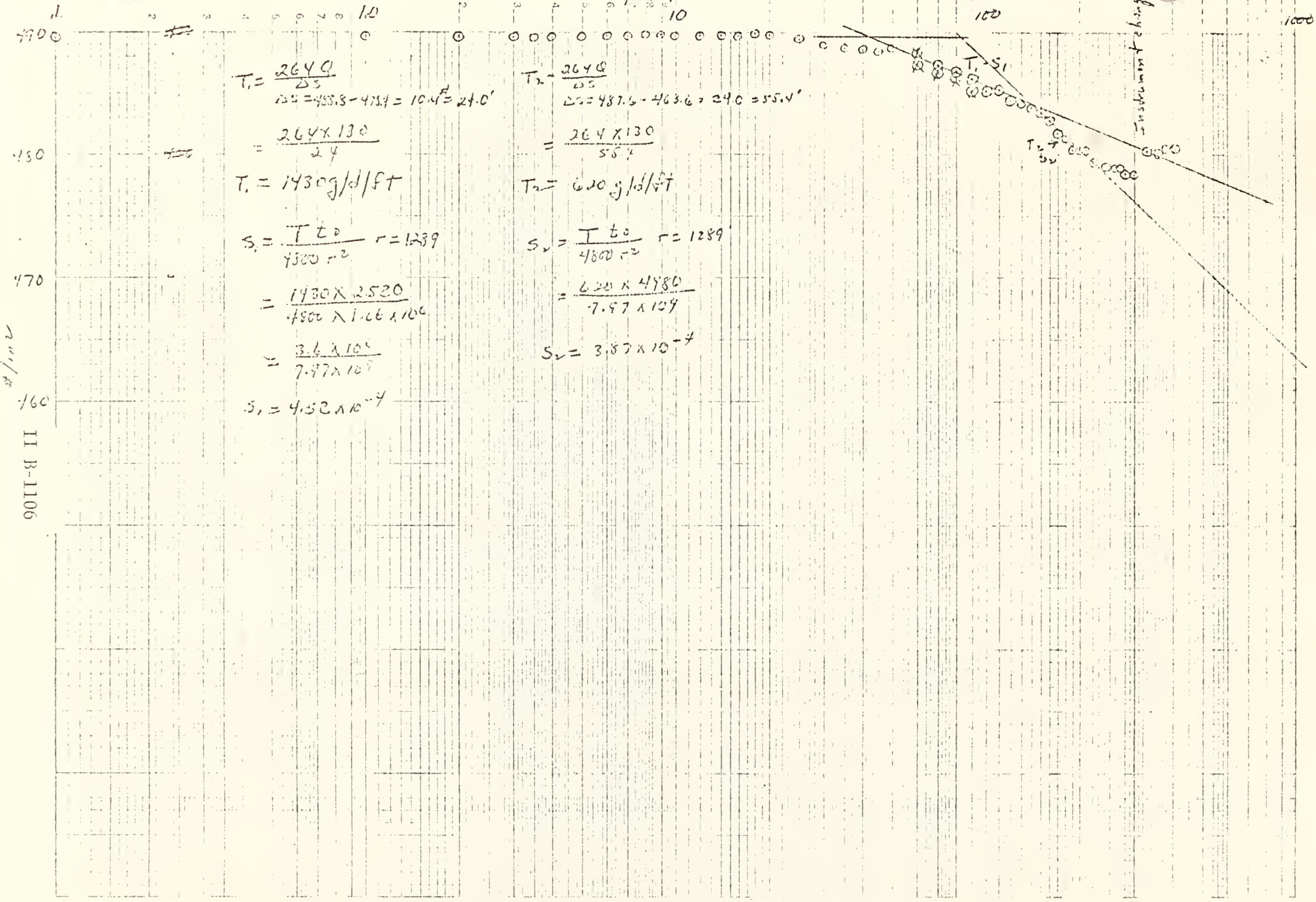


AT #1D. - string #1 Drawdown Test 2-28-75 - 3-10-75

K&E SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 6013

Time in hours since pump turned on



$T_1 = \frac{264Q}{\Delta s}$

$\Delta s = 488.8 - 478.4 = 10.4' = 24.0'$

$= \frac{264 \times 130}{24}$

$T_1 = 1430$ g/d/ft

$S_1 = \frac{T t_0}{4800 r^2}$ $r = 1289$

$= \frac{1430 \times 2520}{4800 \times 1.66 \times 10^6}$

$= \frac{3.6 \times 10^6}{7.97 \times 10^9}$

$S_1 = 4.52 \times 10^{-4}$

$T_2 = \frac{264Q}{\Delta s}$

$\Delta s = 487.6 - 463.6 = 24.0 = 55.4'$

$= \frac{264 \times 130}{55.4}$

$T_2 = 620$ g/d/ft

$S_2 = \frac{T t_0}{4800 r^2}$ $r = 1289$

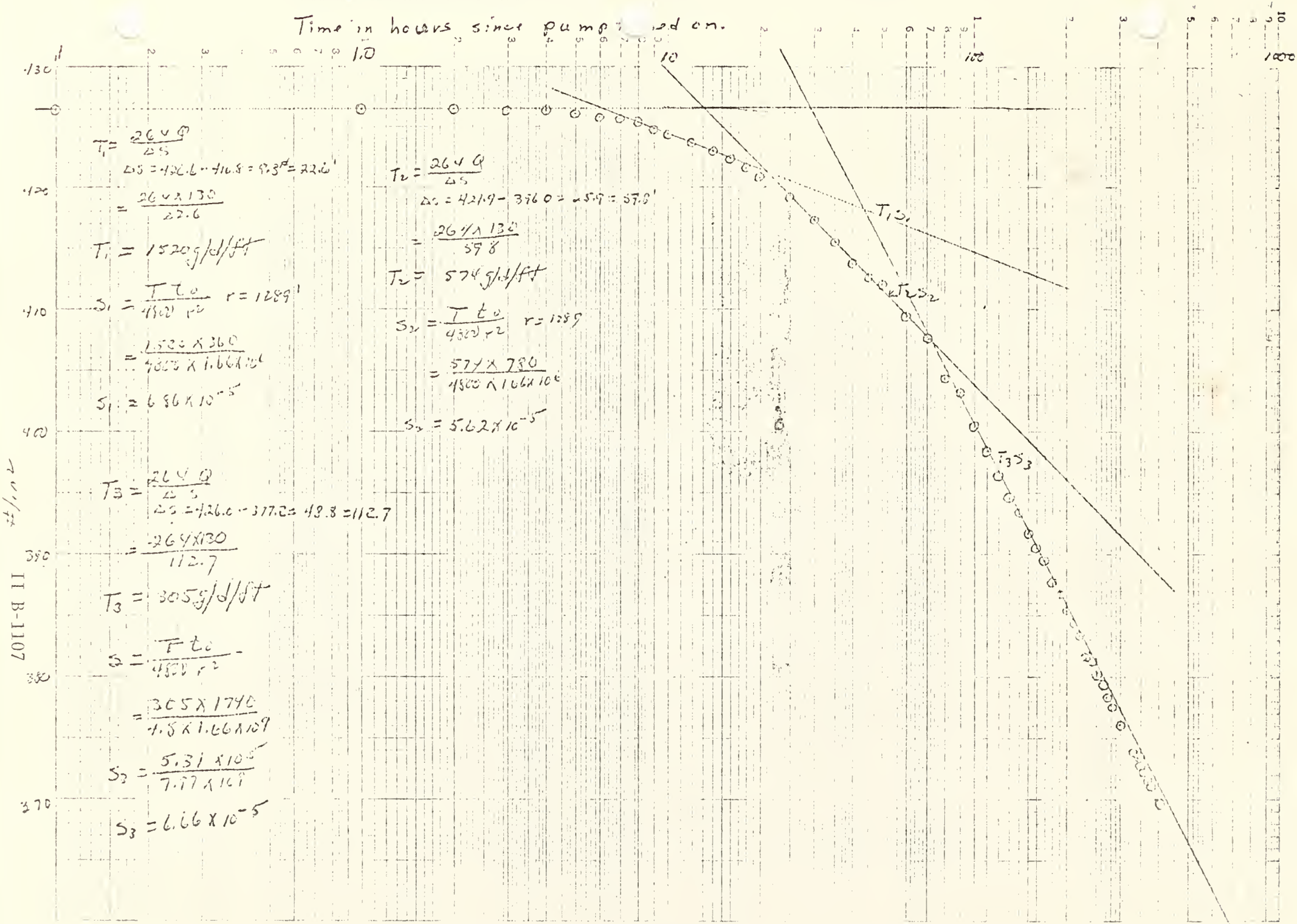
$= \frac{620 \times 4980}{7.97 \times 10^9}$

$S_2 = 3.87 \times 10^{-4}$

II B-1106

56-#6-#1 Siding Drawdown Test 2-28-75 - 3-10-75

SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 6513



$T_1 = \frac{264 Q}{\Delta s}$

$\Delta s = 426.6 - 416.8 = 9.8' = 22.6'$

$= \frac{264 \times 130}{22.6}$

$T_1 = 1520$ g/d/ft

$S_1 = \frac{T t_0}{4800 r^2}$ $r = 1289'$

$= \frac{1520 \times 360}{4800 \times 1.66 \times 10^6}$

$S_1 = 6.86 \times 10^{-5}$

$T_2 = \frac{264 Q}{\Delta s}$

$\Delta s = 421.9 - 396.0 = 25.9 = 57.8'$

$= \frac{264 \times 130}{57.8}$

$T_2 = 594$ g/d/ft

$S_2 = \frac{T t_0}{4800 r^2}$ $r = 1289$

$= \frac{594 \times 730}{4800 \times 1.66 \times 10^6}$

$S_2 = 5.62 \times 10^{-5}$

$T_3 = \frac{264 Q}{\Delta s}$

$\Delta s = 426.6 - 377.2 = 49.8 = 112.7$

$= \frac{264 \times 130}{112.7}$

$T_3 = 305$ g/d/ft

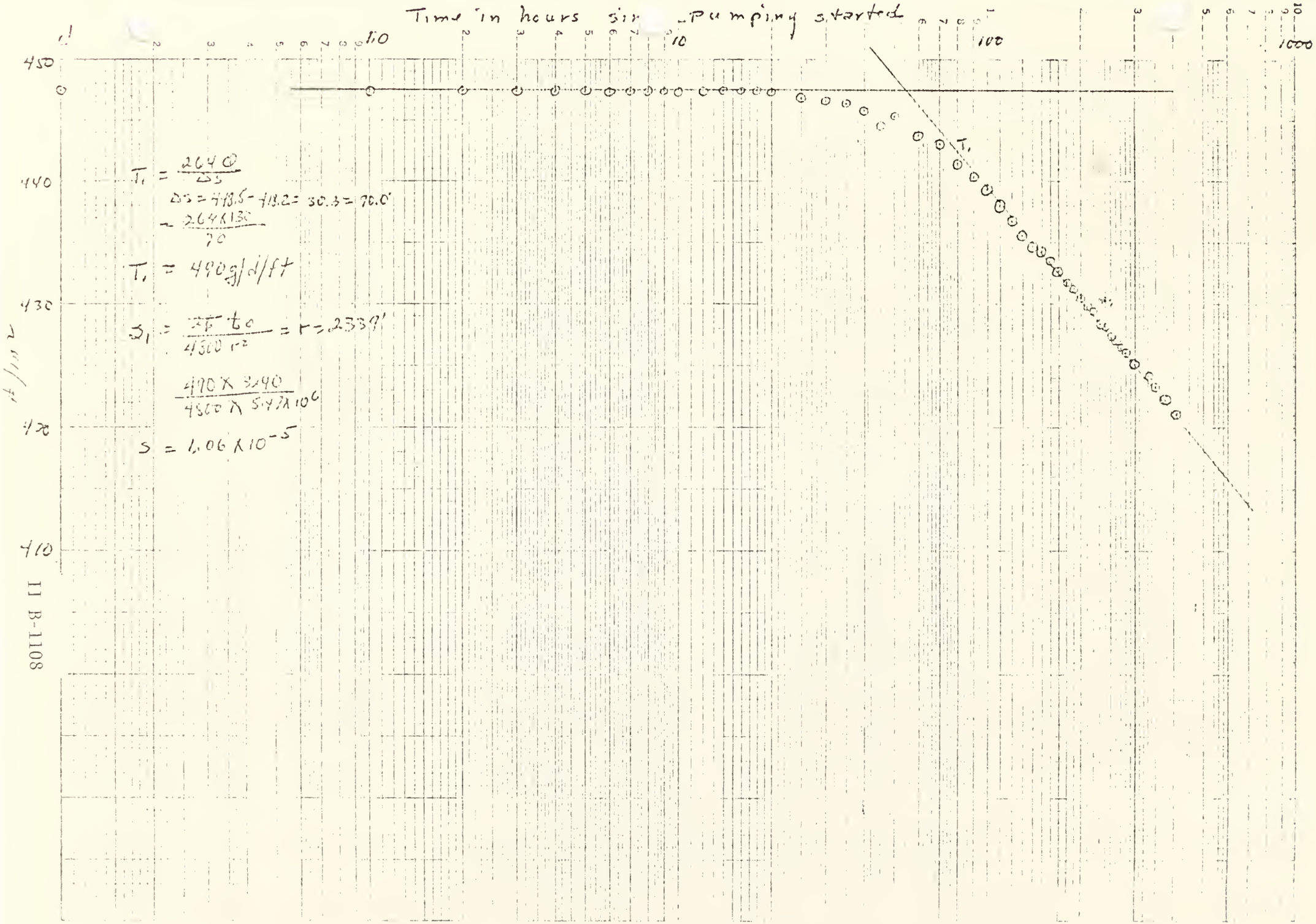
$S_3 = \frac{T t_0}{4800 r^2}$

$= \frac{305 \times 1740}{4.8 \times 1.66 \times 10^9}$

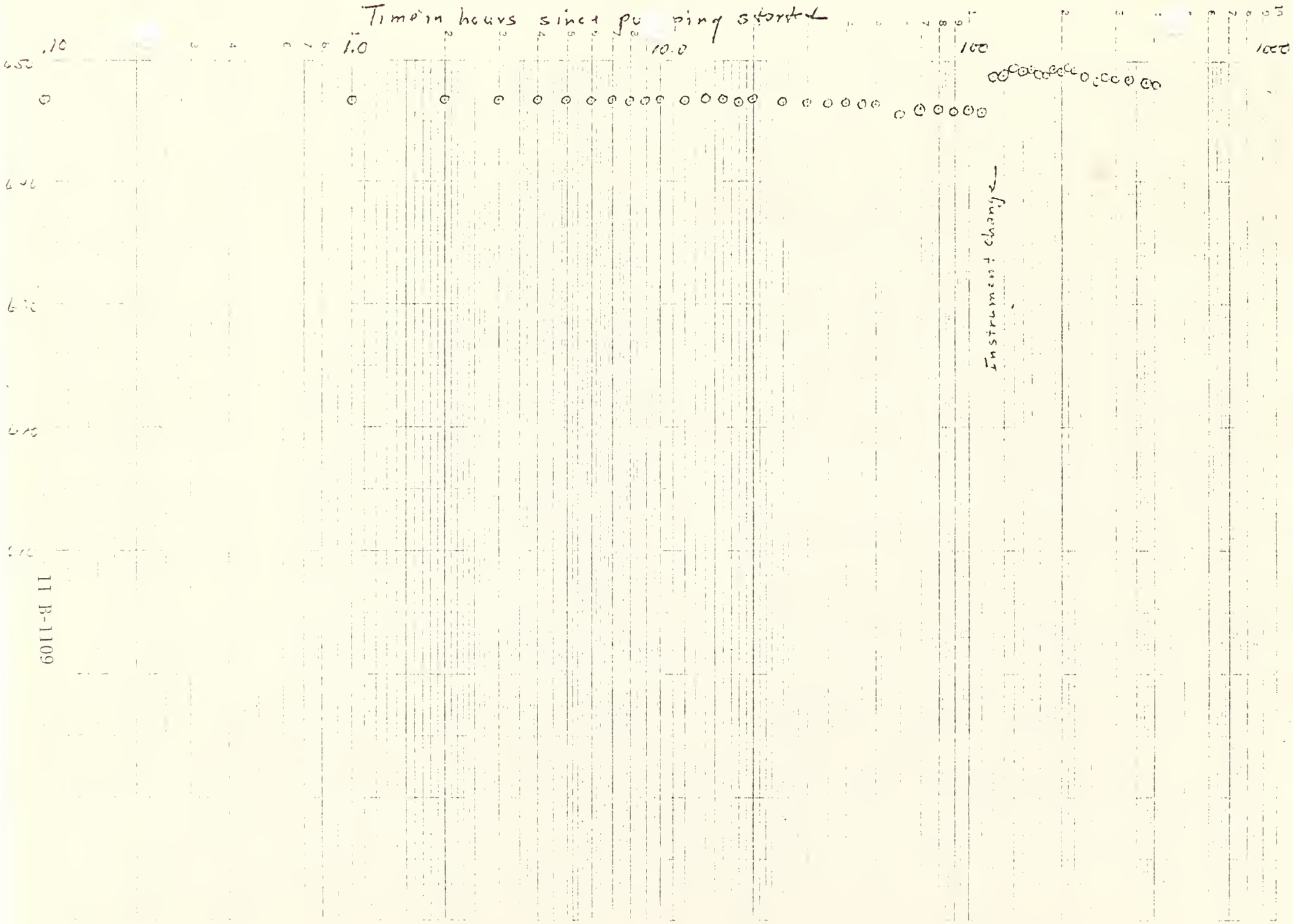
$S_3 = \frac{5.31 \times 10^5}{7.97 \times 10^9}$

$S_3 = 6.66 \times 10^{-5}$

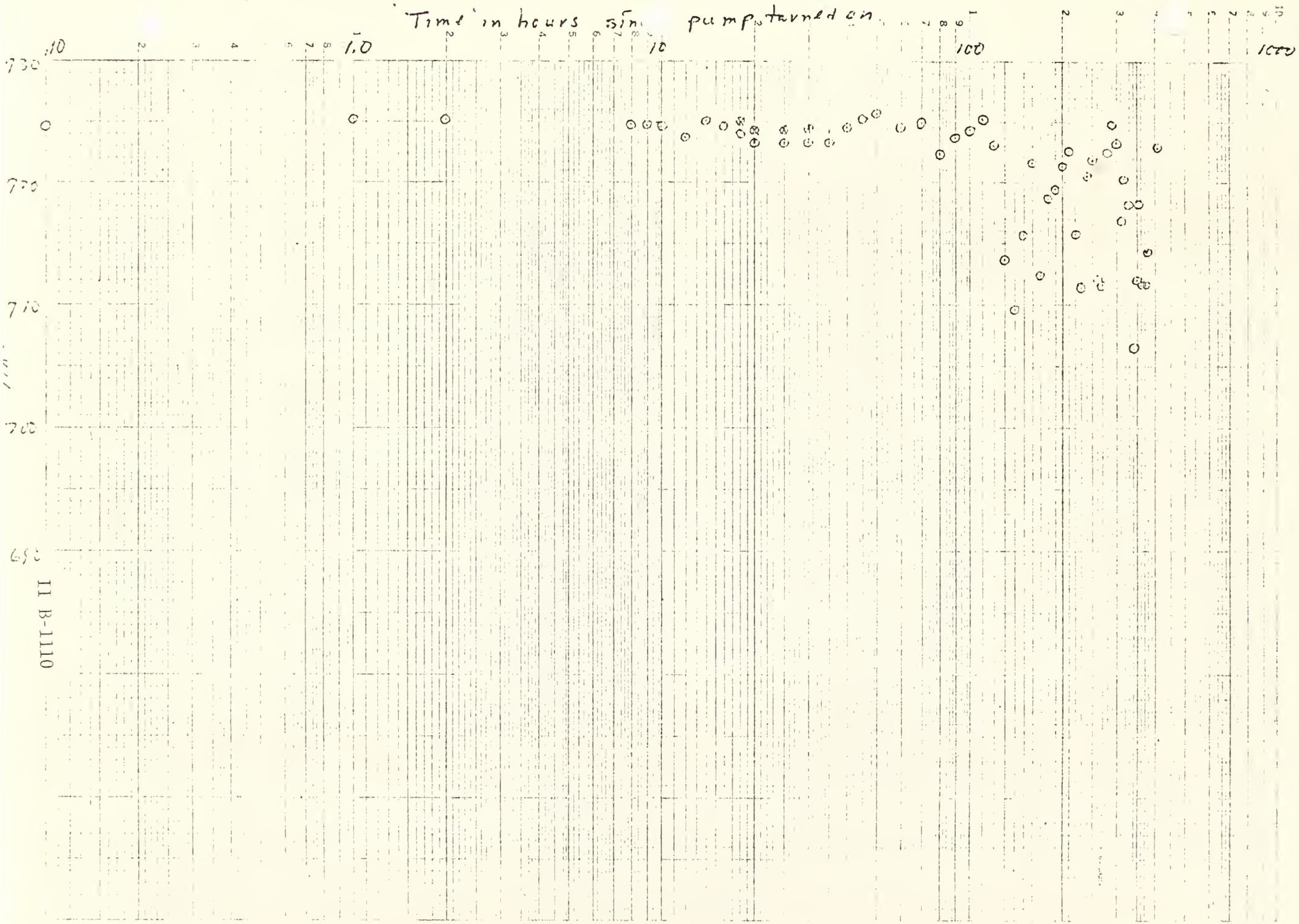
SG-6 #2 String Drawdown Test - 2-27-75 — 3-10-75



SG-10 - #1 string. Drawdown Test 2-27-75 — 3-10-75



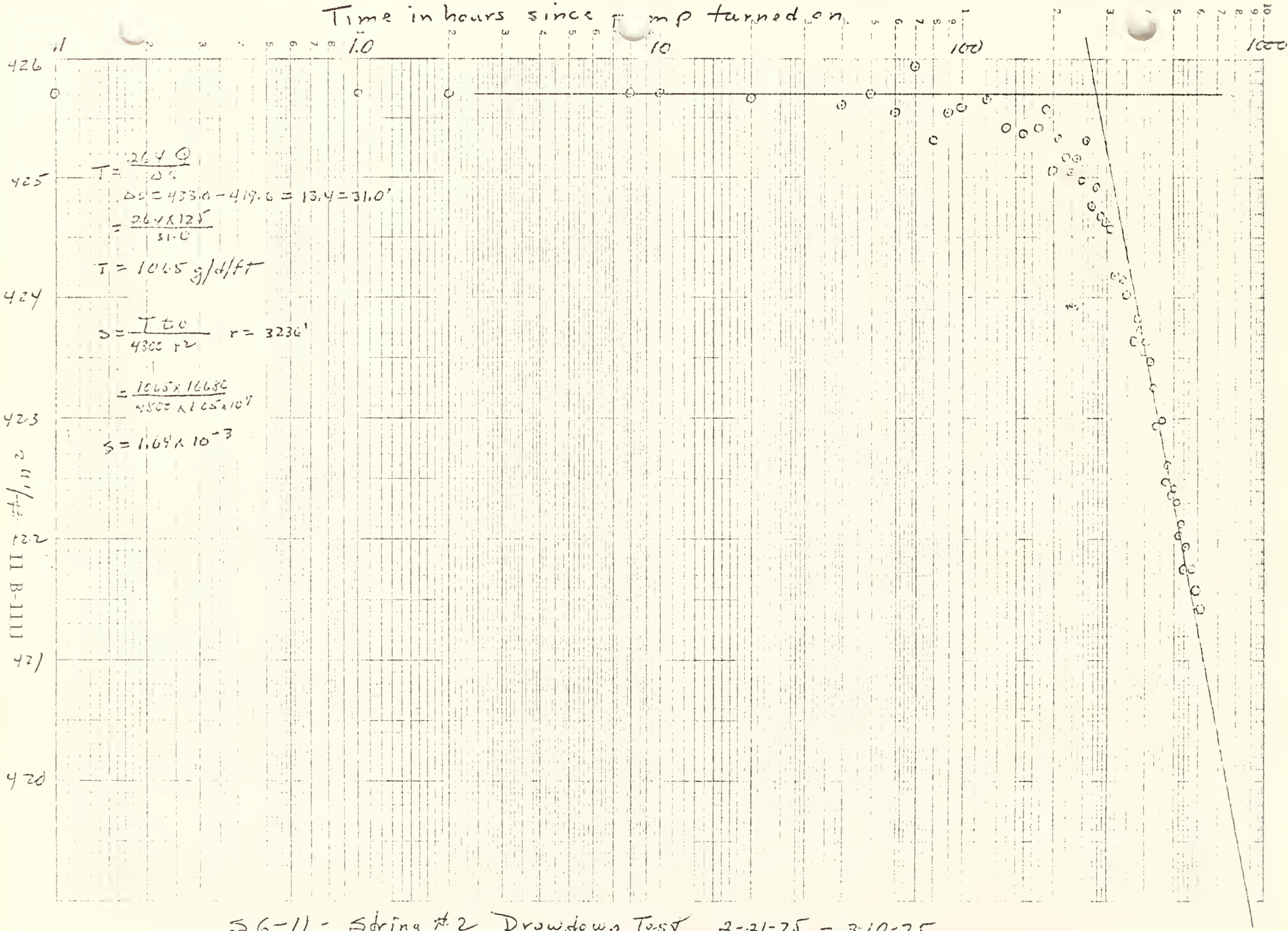
S6-10 #2 string Drawdown Test 2-27-75 – 3-10-75



SG-11 String #1 Drawdown Test 2-21-75 — 3-10-75

KEUFFEL & ESSER CO. MADE IN U.S.A. 46 0013

Time in hours since pump turned on



$T = \frac{264\,Q}{\Delta s}$

$\Delta s = 433.0 - 419.6 = 13.4 = 31.0'$

$= \frac{264 \times 125}{31.0}$

$T = 1065$ g/d/ft

$S = \frac{T\,t_0}{4800\,r^2}$ $r = 3236'$

$= \frac{1065 \times 16680}{4800 \times 1.05 \times 10^7}$

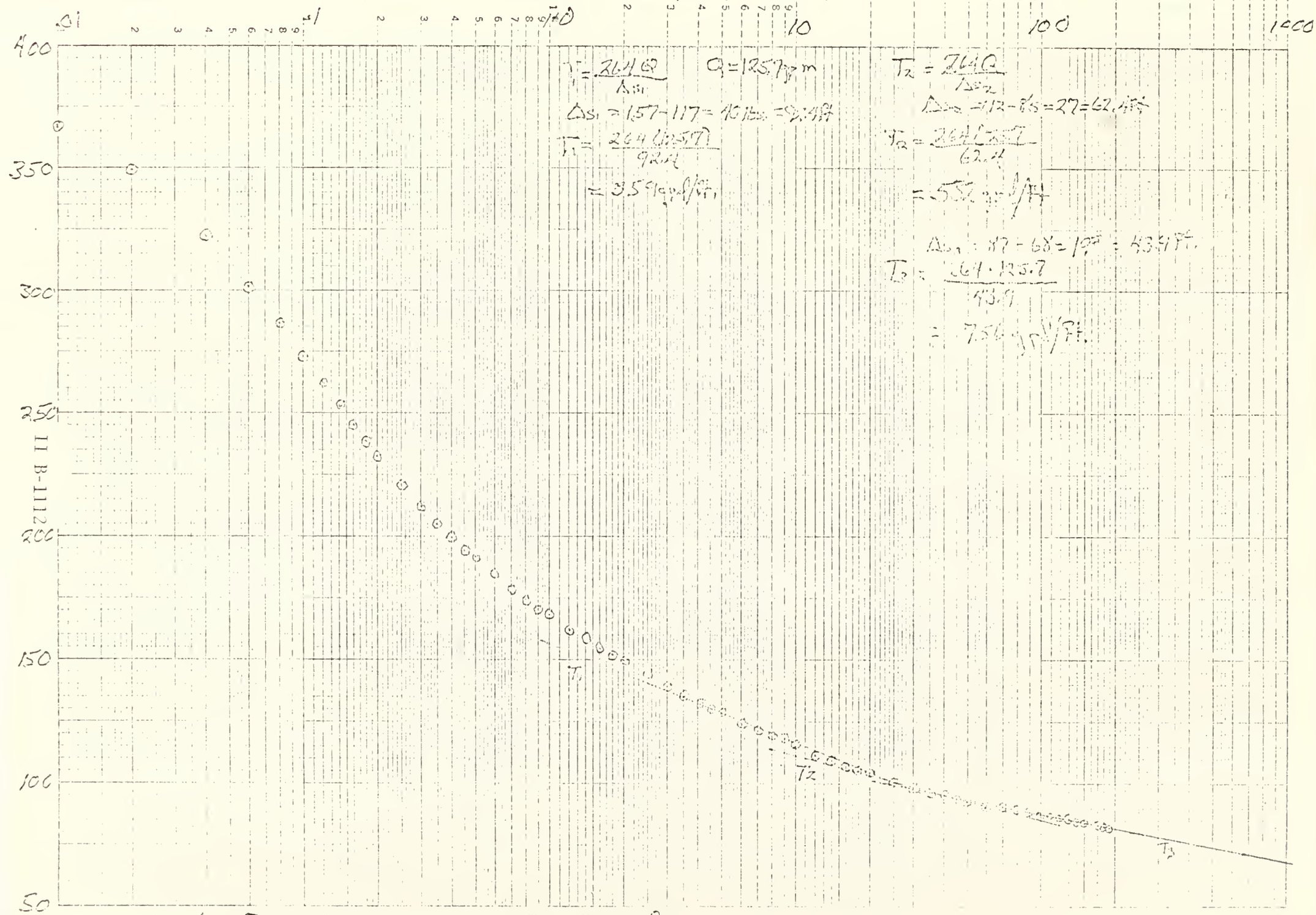
$S = 1.69 \times 10^{-3}$

S6-11 - String #2 Drawdown Test 2-21-75 - 3-10-75

K+E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 6212

Time in Hours since pump turned on



$T_1 = \frac{264Q}{\Delta s_1}$ $Q = 125.7$ gpm

$\Delta s_1 = 157 - 117 = 40$ ft $= 92.4$ ft

$T_1 = \frac{264(125.7)}{92.4}$

$= 359$ gpd/ft

$T_2 = \frac{264Q}{\Delta s_2}$

$\Delta s_2 = 112 - 85 = 27 = 62.4$ ft

$T_2 = \frac{264(125.7)}{62.4}$

$= 532$ gpd/ft

$\Delta s_3 = 87 - 68 = 19$ ft $= 43.9$ ft

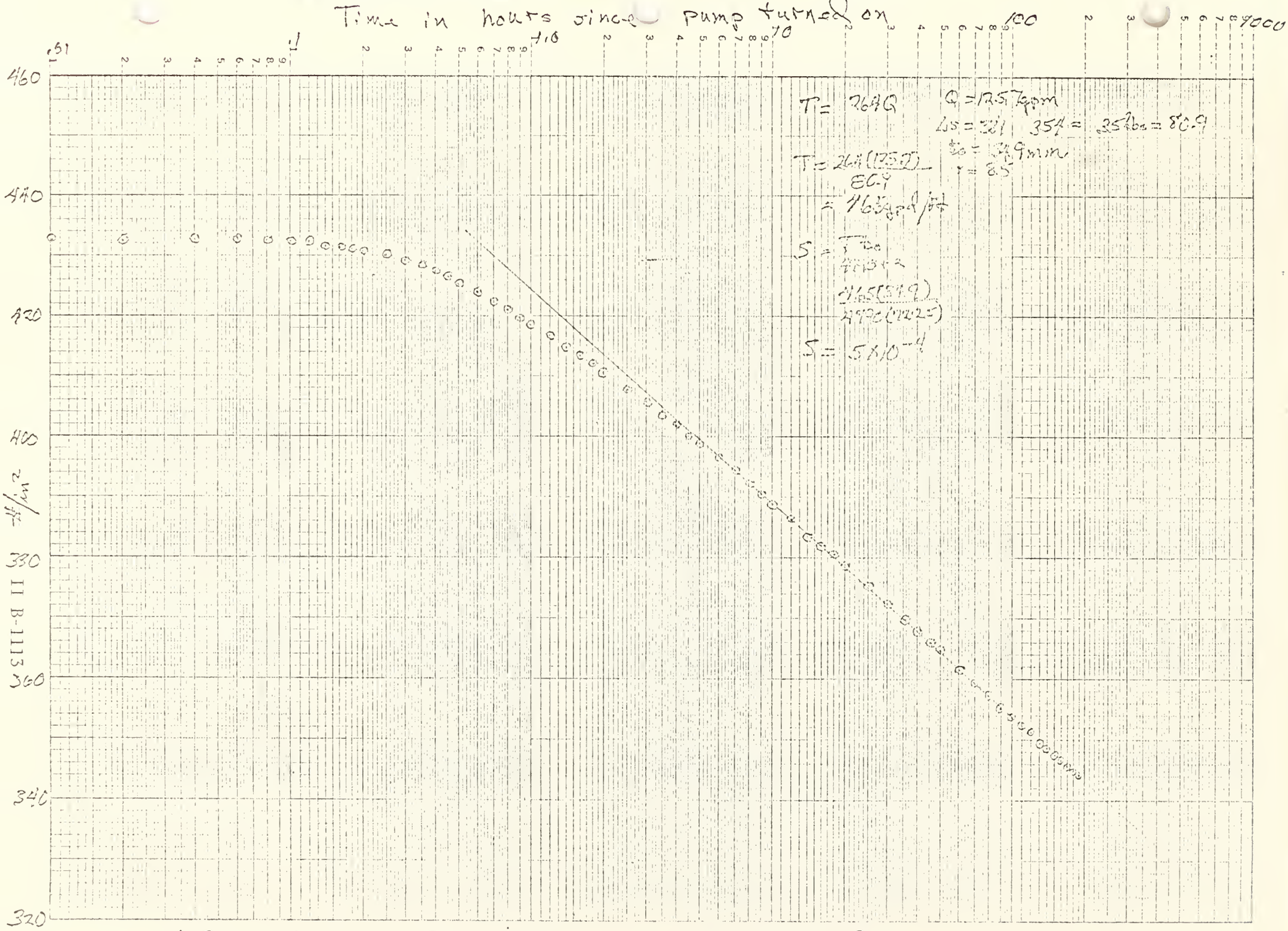
$T_3 = \frac{264 \cdot 125.7}{43.9}$

$= 756$ gpd/ft

A-#1 Pulsetest Lower Aquifer - Drawdown 3-18-75 —— 3-26-75

K+E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 6212

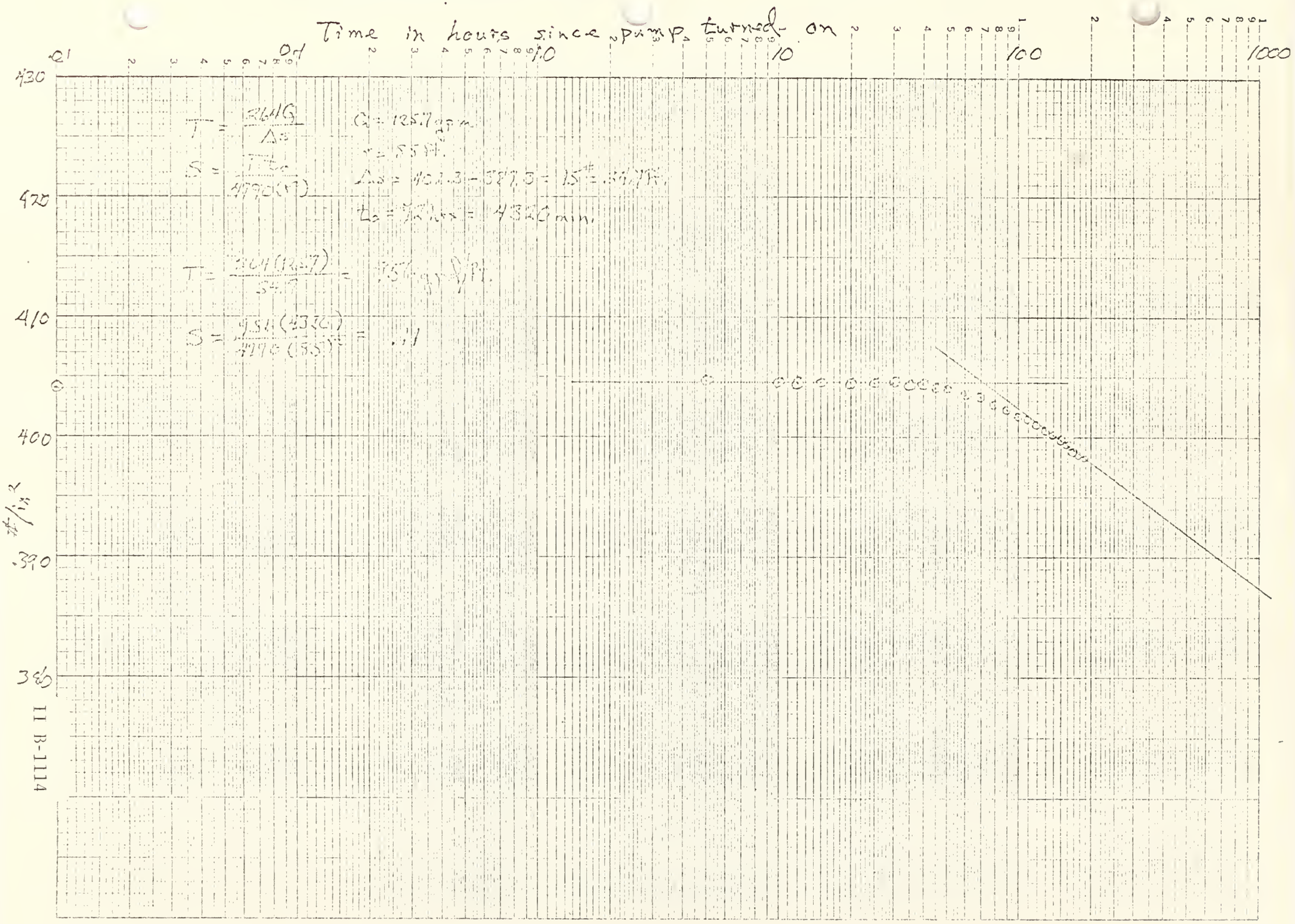


II B-1113

AT-1A String #1 Pulse test Lower Aquifer - Drawdown 3-18-75 → 3-26-75

K+E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 6212

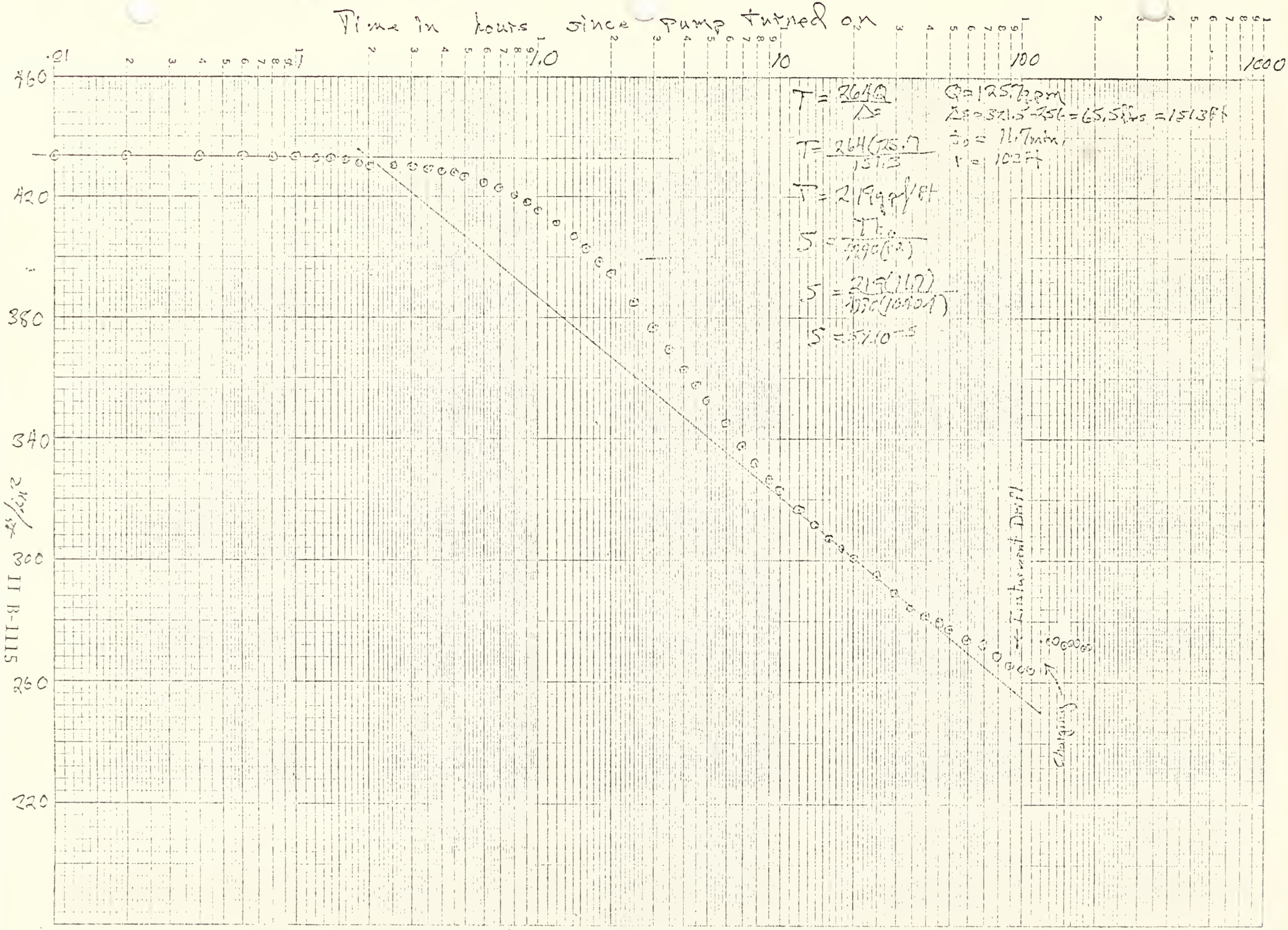


4t-1A String #2 Pulsetest Lowest Aquifer - Drawdown .3-18-25 → 3-26-75

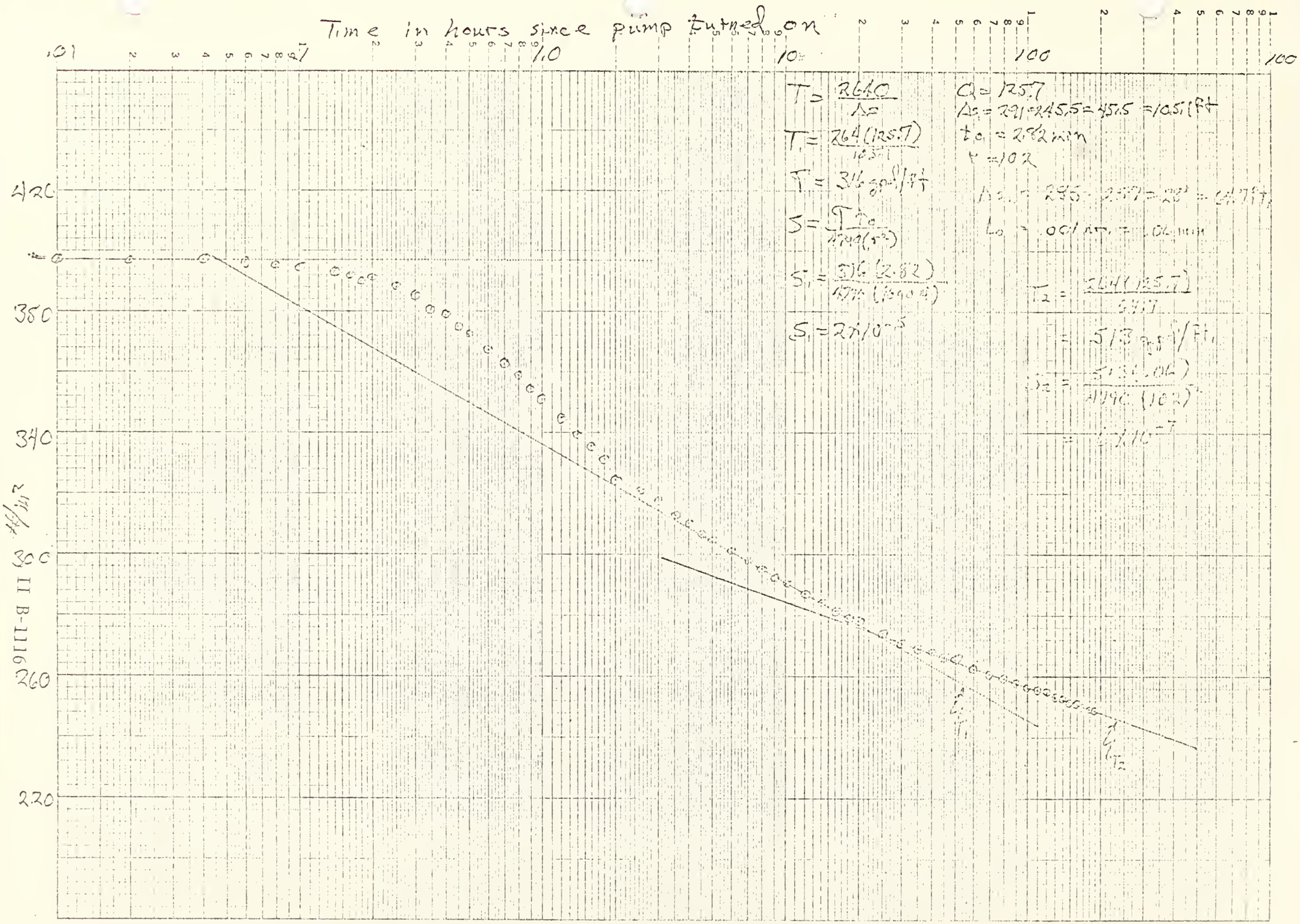
II B-1114

K+E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 6212



At-1C String #1 Pulse Test Lower Aquifer test - Drawdown 3-18-75 → 3-26-75

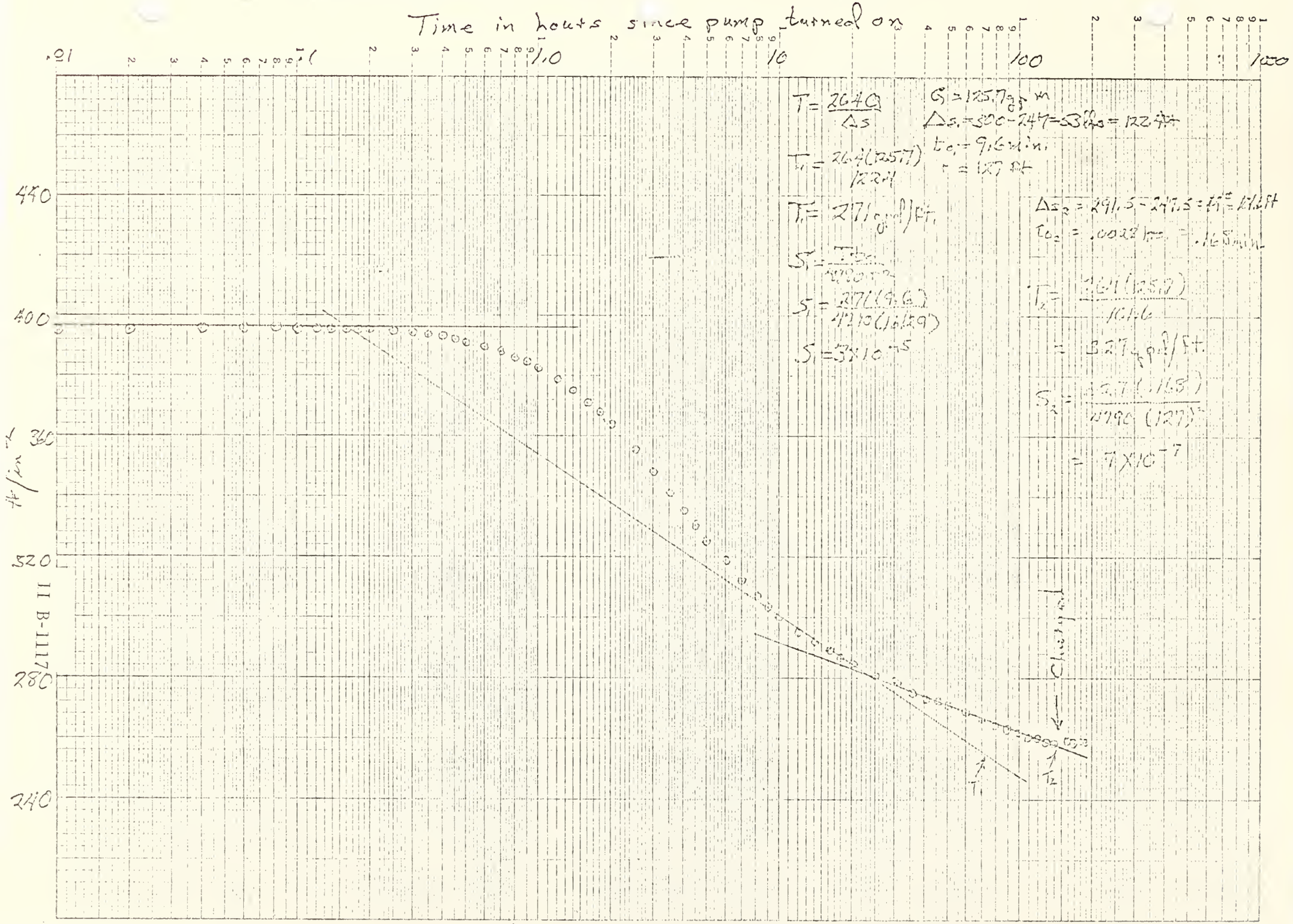


ATIC String #2 Pulse Test Lower Aquifer - Drawdown 3-18-75 → 3-26-75

II B-1116

K+E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 6212

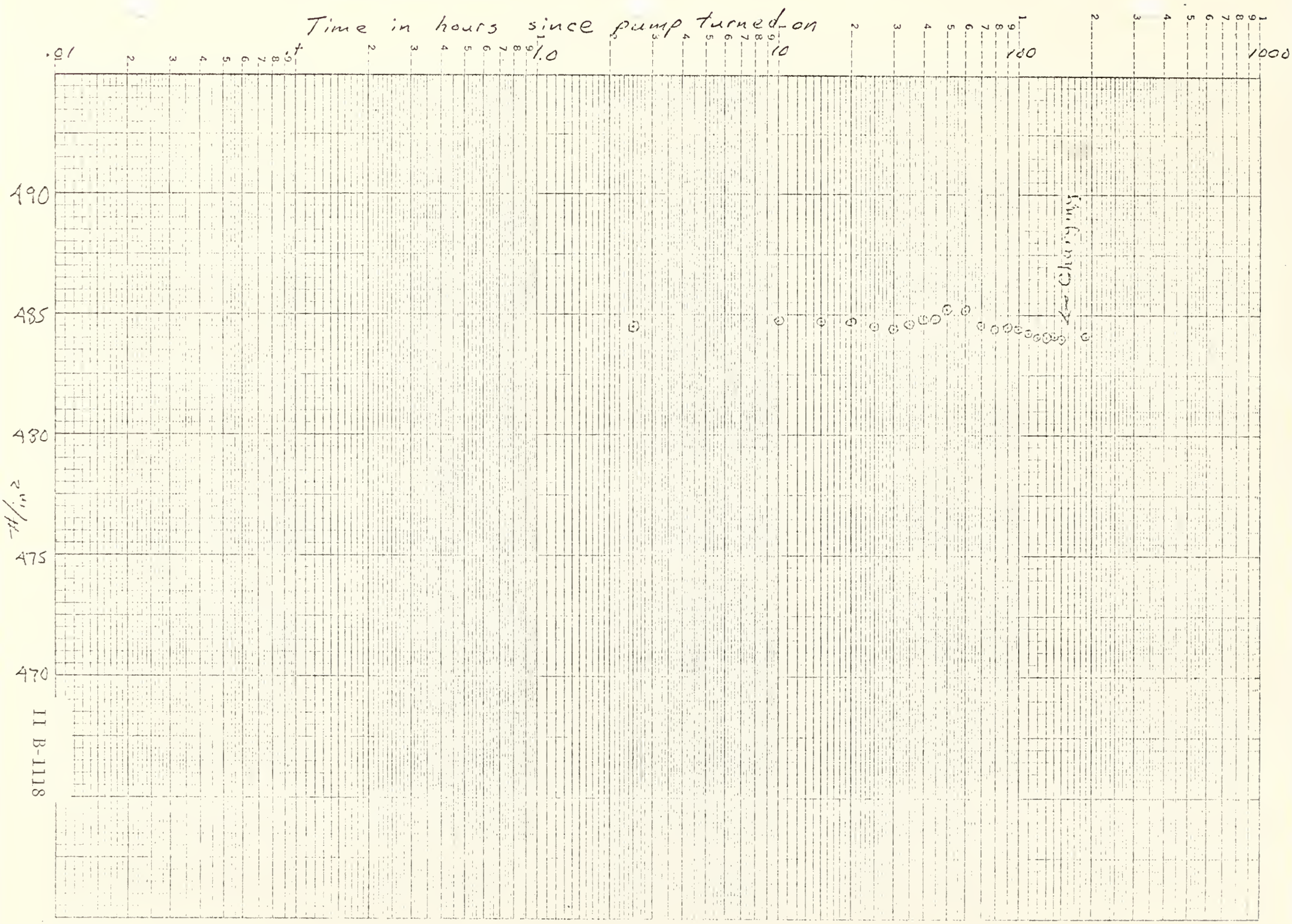


AT-1D -String #2 Lower Aquifer Pulse Test - Drawdown 3-18-75 ⟶ 3-26-75

II B-1117

K+E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

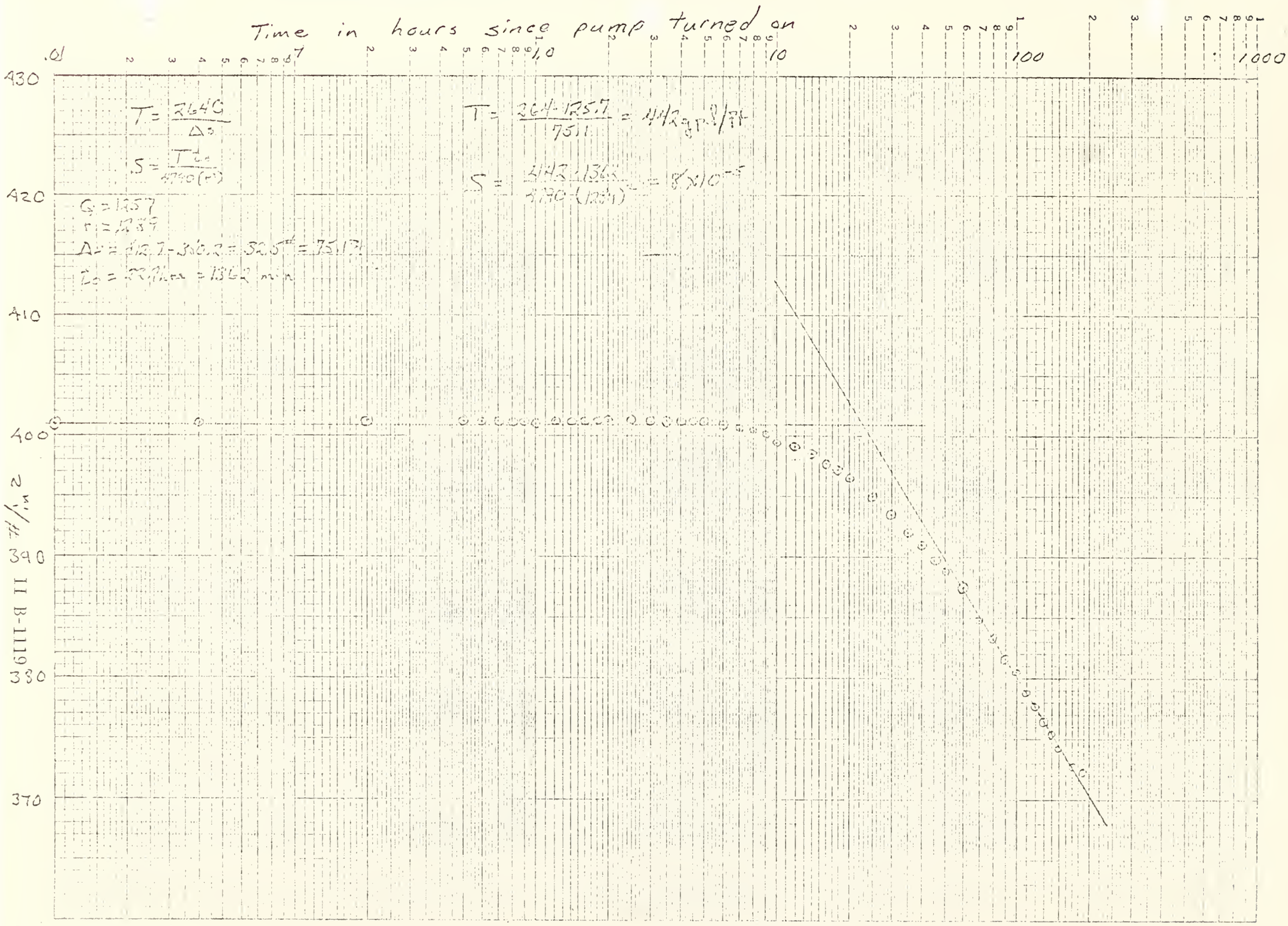
46 6212



II B-1118

Pulse Test Lower Aquifer SG-6 #1 String Drawdown Test 3-18-75 — 3-26-75

K+E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
40 0212

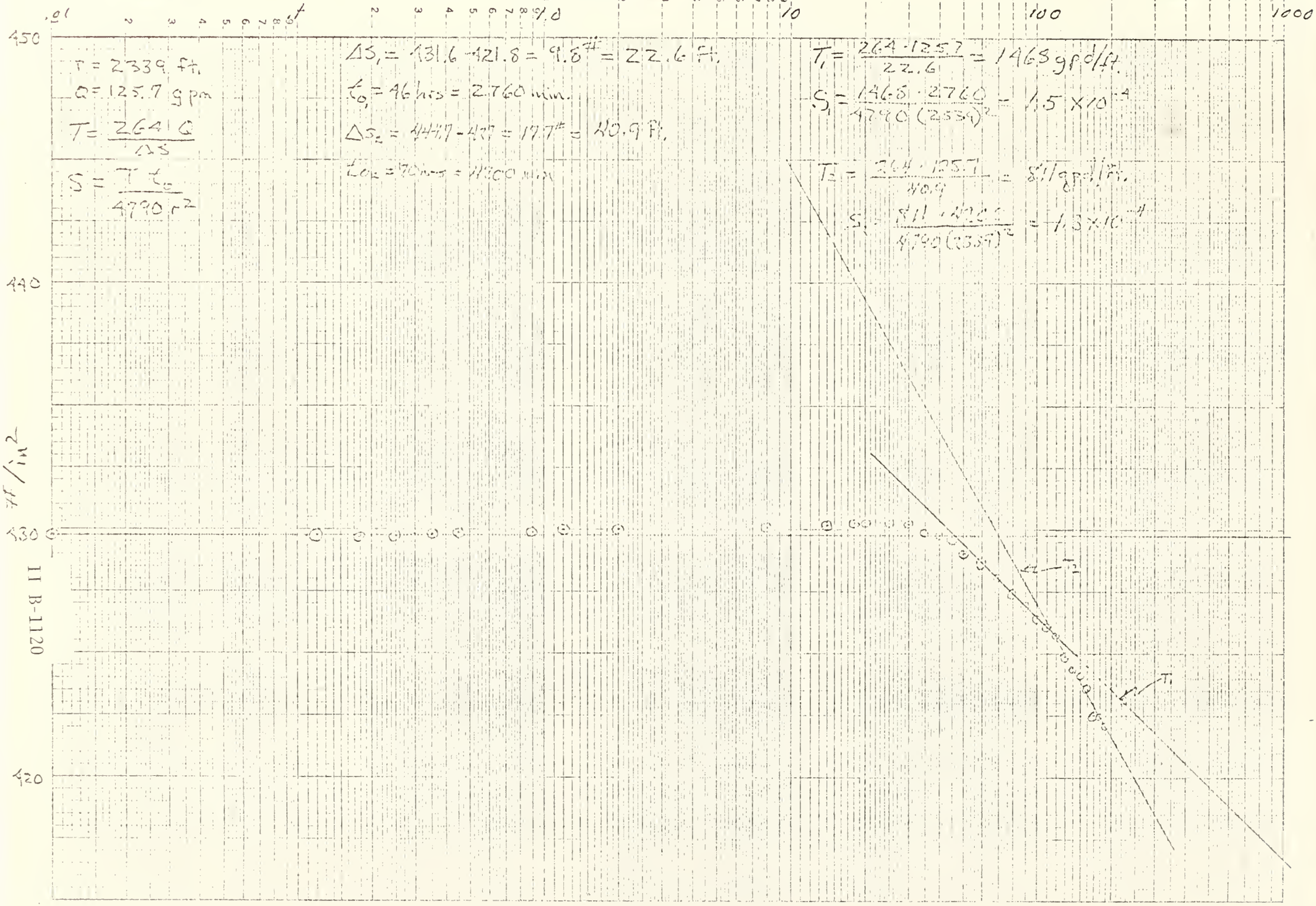


Pulse Test Lower Aquifer 56-6 #2 String Drawdown Test 3-18-75 — 3-26-75

K&E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 6212

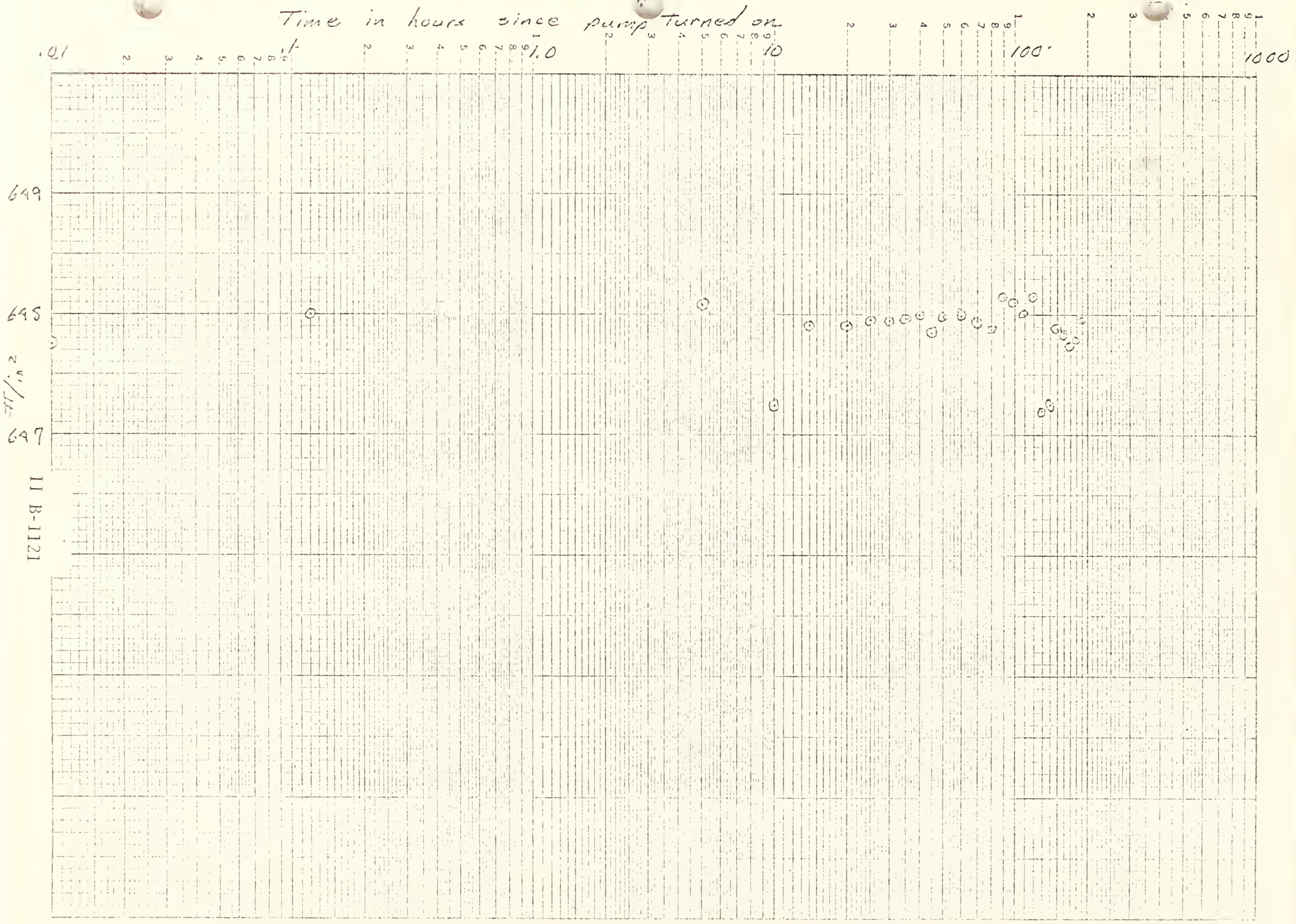
Time in hours since pump turned on



II B-1120

Pulse Test 56-10 String #1 Drawdown Test 3-18-75 — Lower Aquifer 3-26-75

K+E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 6212

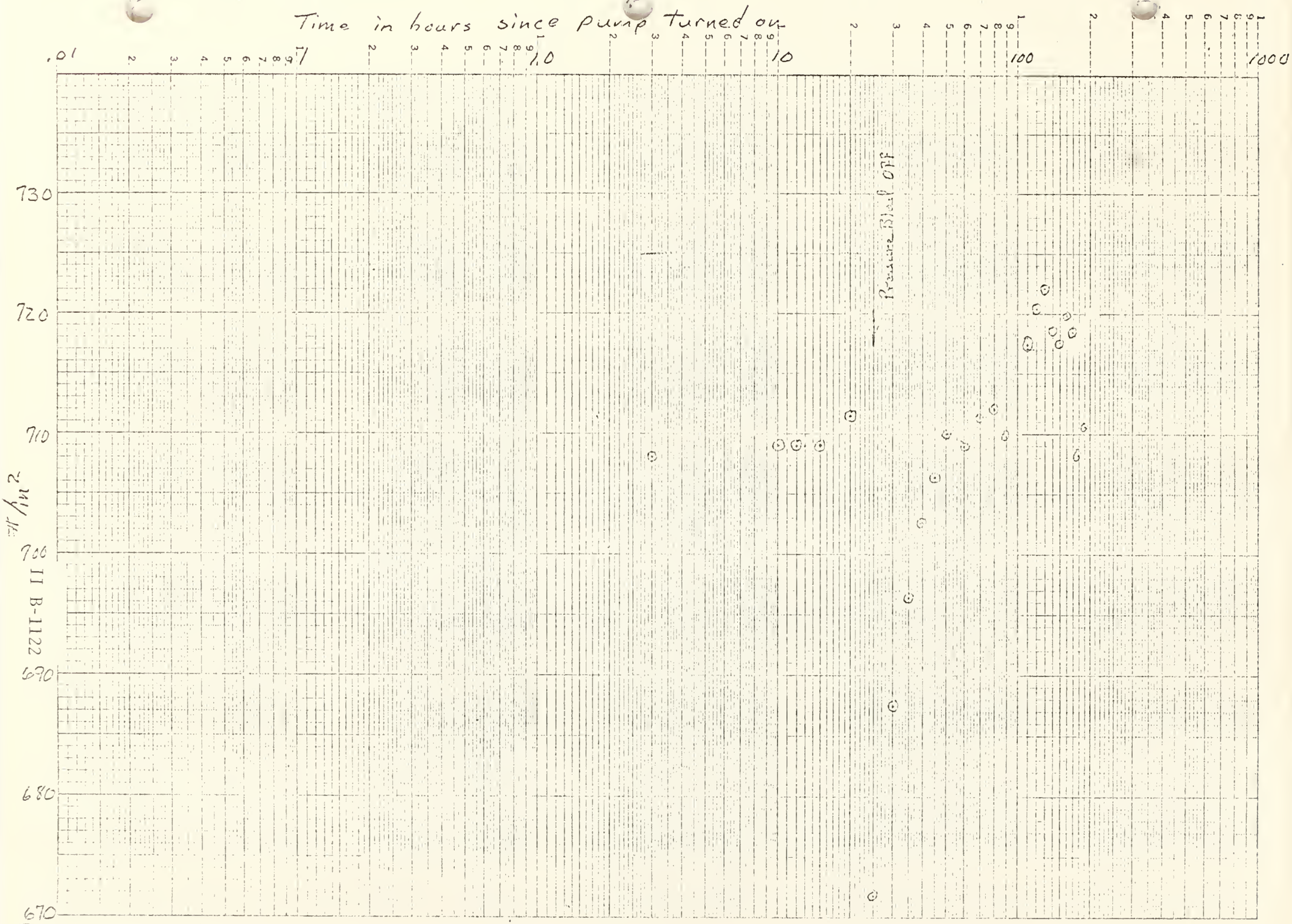


Pulse Test 56-10 string #2 Drawdown 3-18-75 — Lower Aquifer 3-26-75

II B-1121

K+E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

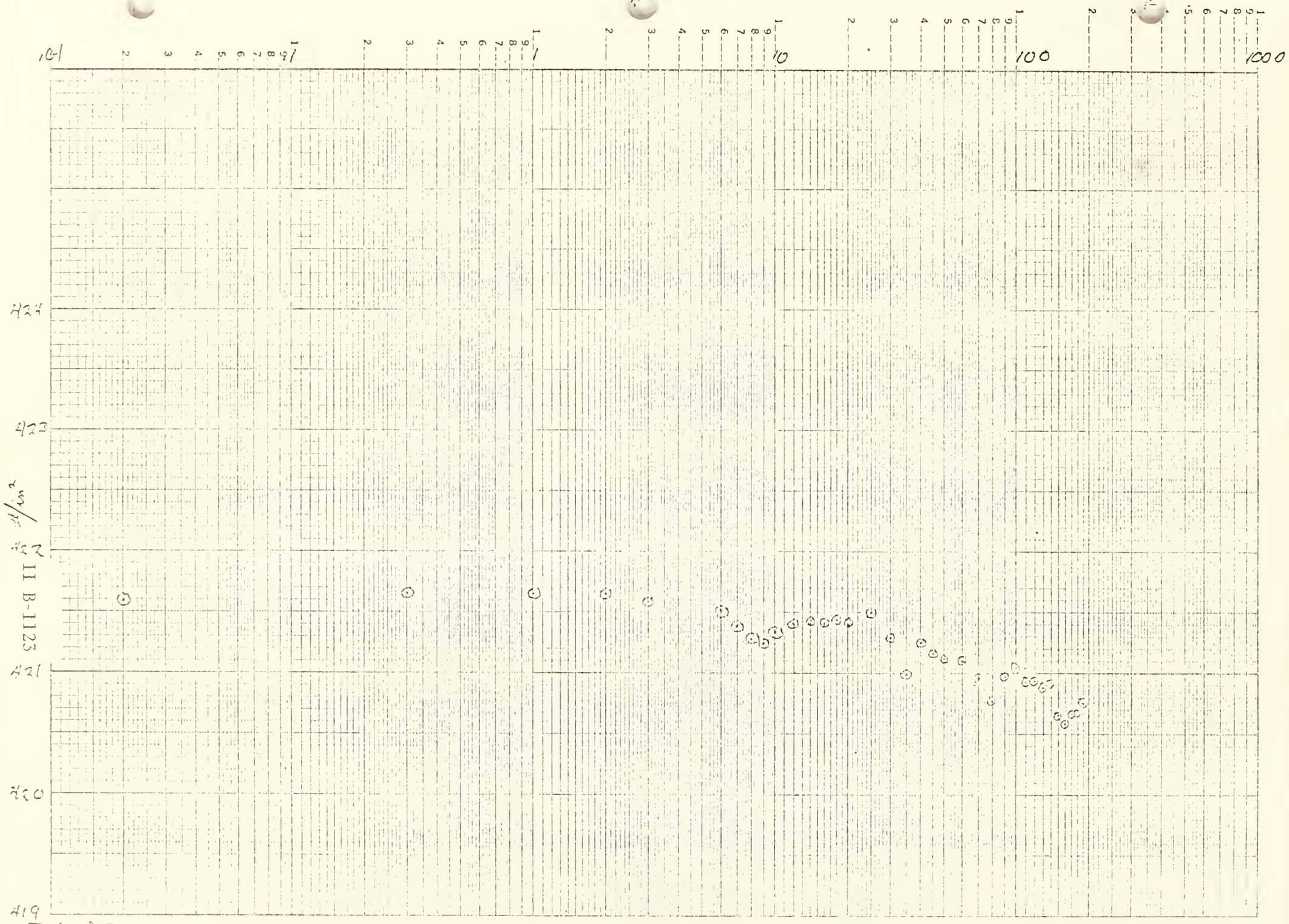
46 6212



II B-1122

Pulse Test Lower Aquifer SG-11 String #1 Drawdown Test 3-18-75 — 3-26-75

K&E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.



Pulse Test Lower Aquifer SG-11 #2 Stringed Drawdown test 3-18-75 ⟶ 3-26-75

LOWER AQUIFER PUMP TEST

FINAL RECOVERY CURVES

TABLE II B-54

TRANSMISSIVITY and STORAGE COEFFICIENT VALUES

Lower Aquifer Pump Test

Well No.	Final Recovery
AT#1	T = 194.7 gpd/ft. Initial T = 351.0 gpd/ft. Final
AT#1A (String #1)	T = 333.4 gpd/ft.; S = 6.4×10^{-4} Initial T = 365.4 gpd/ft.; S = 5.3×10^{-4} Final
(String #2)	NO VALID RESPONSE
AT#1C (String #1)	T = 133.4 gpd/ft.; S = 1.8×10^{-4} Initial T = 310.3 gpd/ft.; S = 1.5×10^{-5} Final
(String #2)	T = 226 gpd/ft.; S = 5.2×10^{-5} Initial T = 346.9 gpd/ft.; S = 1.4×10^{-5} Final
AT#1D (String #1)	T = 303.2 gpd/ft.; S = 2.5×10^{-5} Initial T = 360.5 gpd/ft.; S = 1.1×10^{-5} Final
SG-6 (String #1)	T = 380.8 gpd/ft.; S = 1.02×10^{-3}
(String #2)	T = 400.5 gpd/ft.; S = 8×10^{-5}
SG-10 (String #1)	T = 694.6 gpd/ft.; S = 1.4×10^{-5}
(String #2)	NO RESPONSE
SG-11 (String #1)	NO USABLE RESPONSE DUE TO HIGH GAS PRESSURE POSSIBLE
(String #2)	NO USABLE RESPONSE DUE TO INSTRUMENT DRIFT

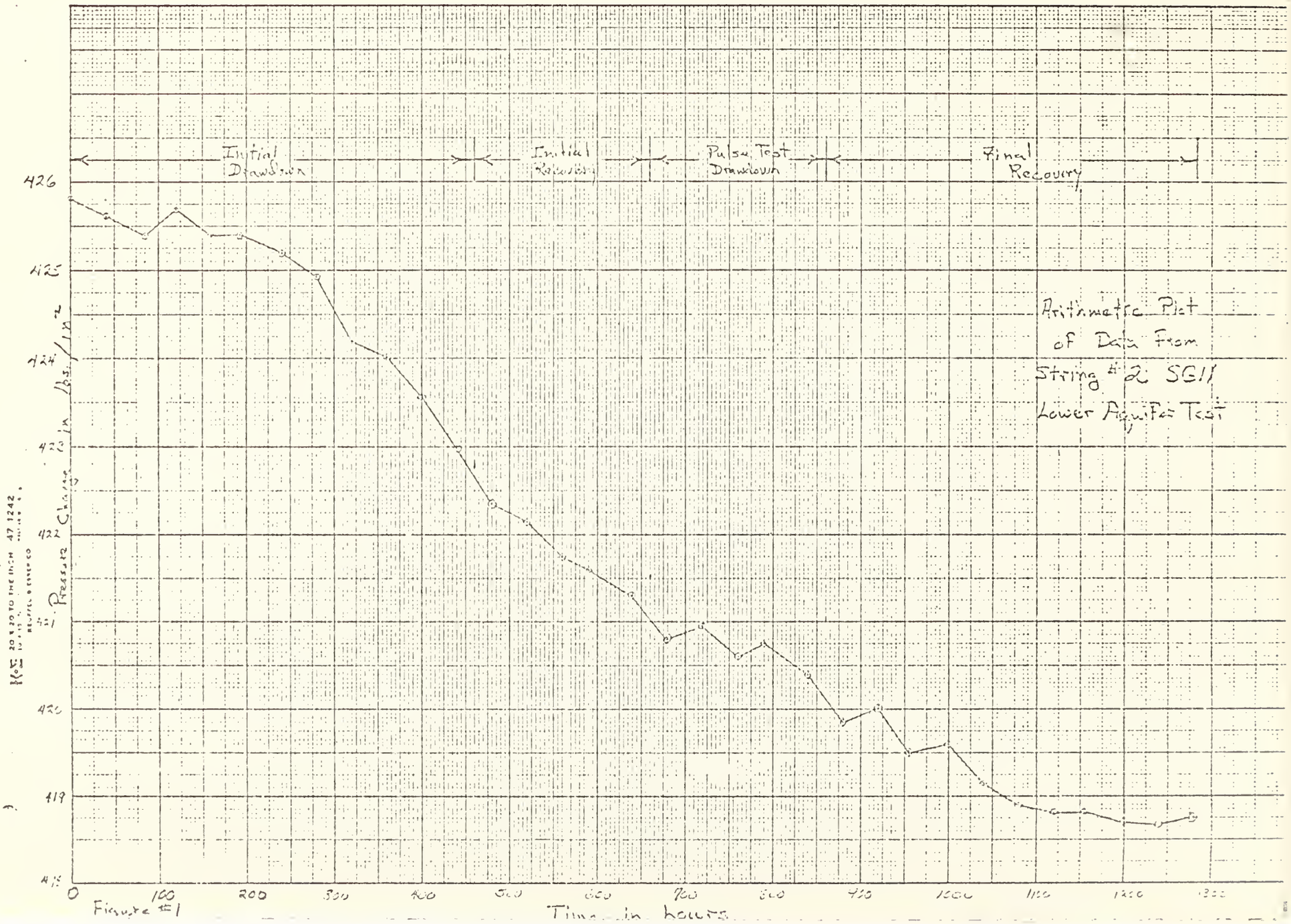

Initial Drawdown
Initial Recovery
Pulse Test Drawdown
Final Recovery
Arithmetic Plot of Data From String #2 SG11 Lower Aquifer Test
Pressure Change in lbs/in²
426
425
424
423
422
421
420
419
418
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
Time in hours

Figure #1

K+E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 6212

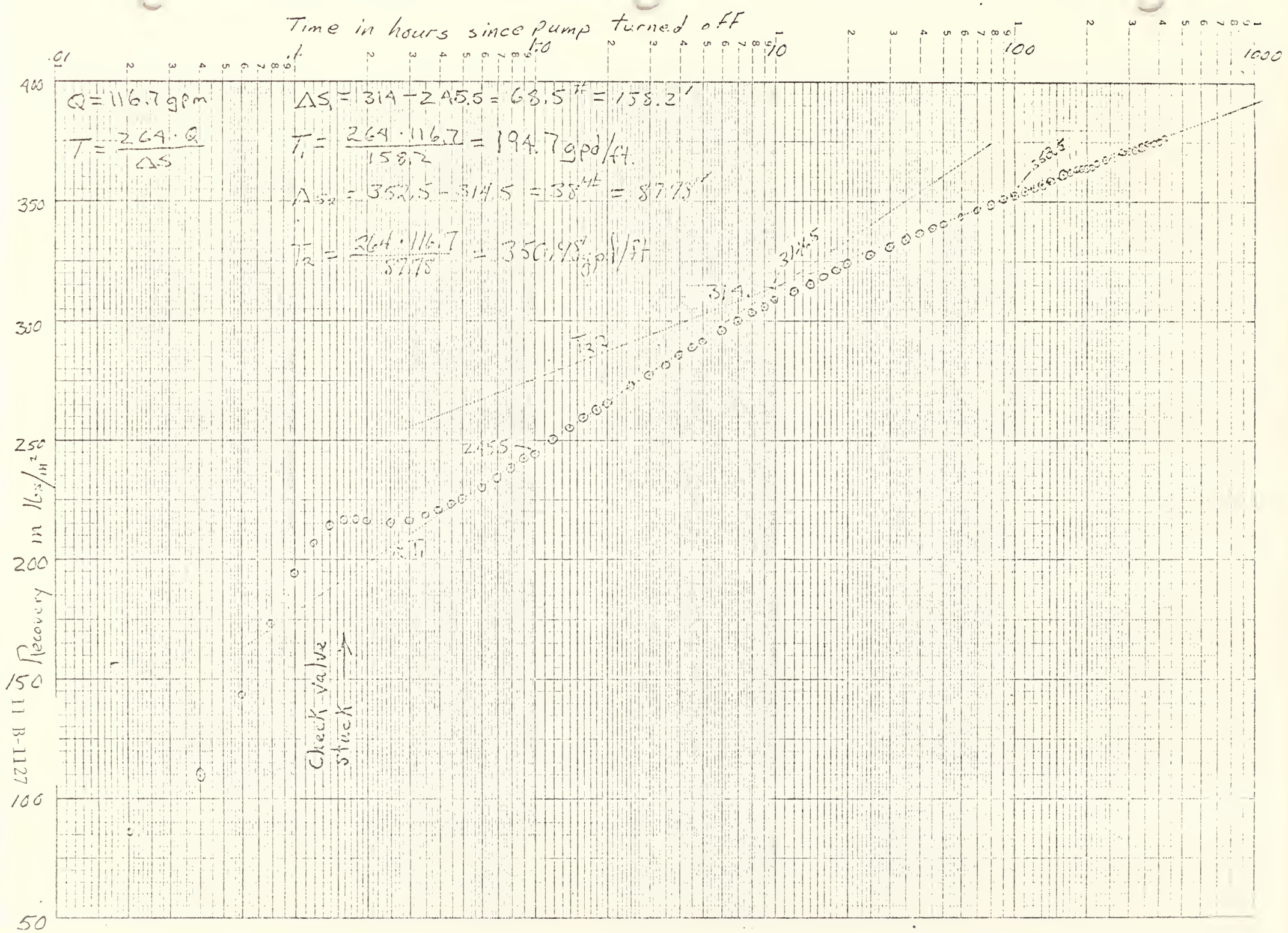
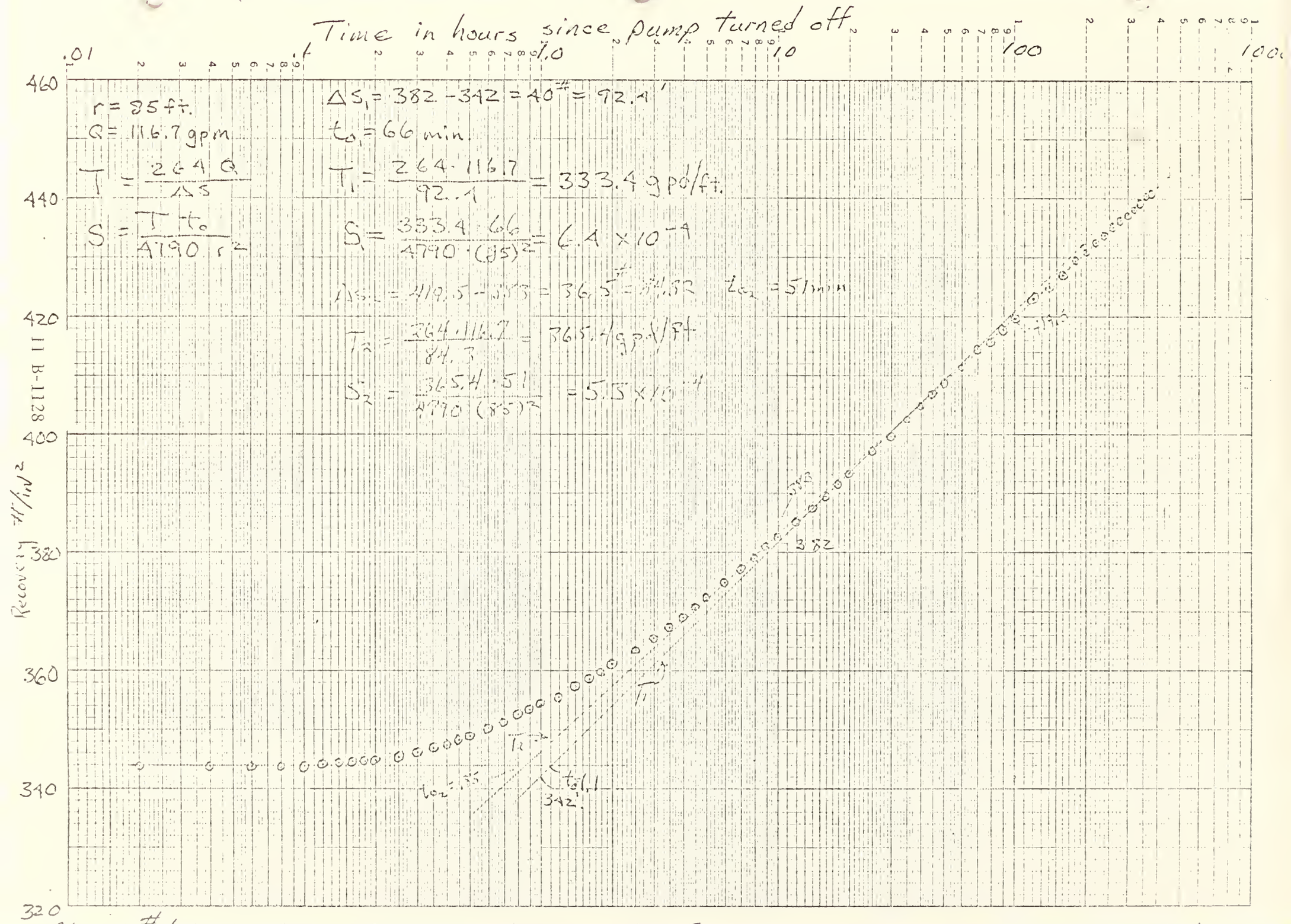
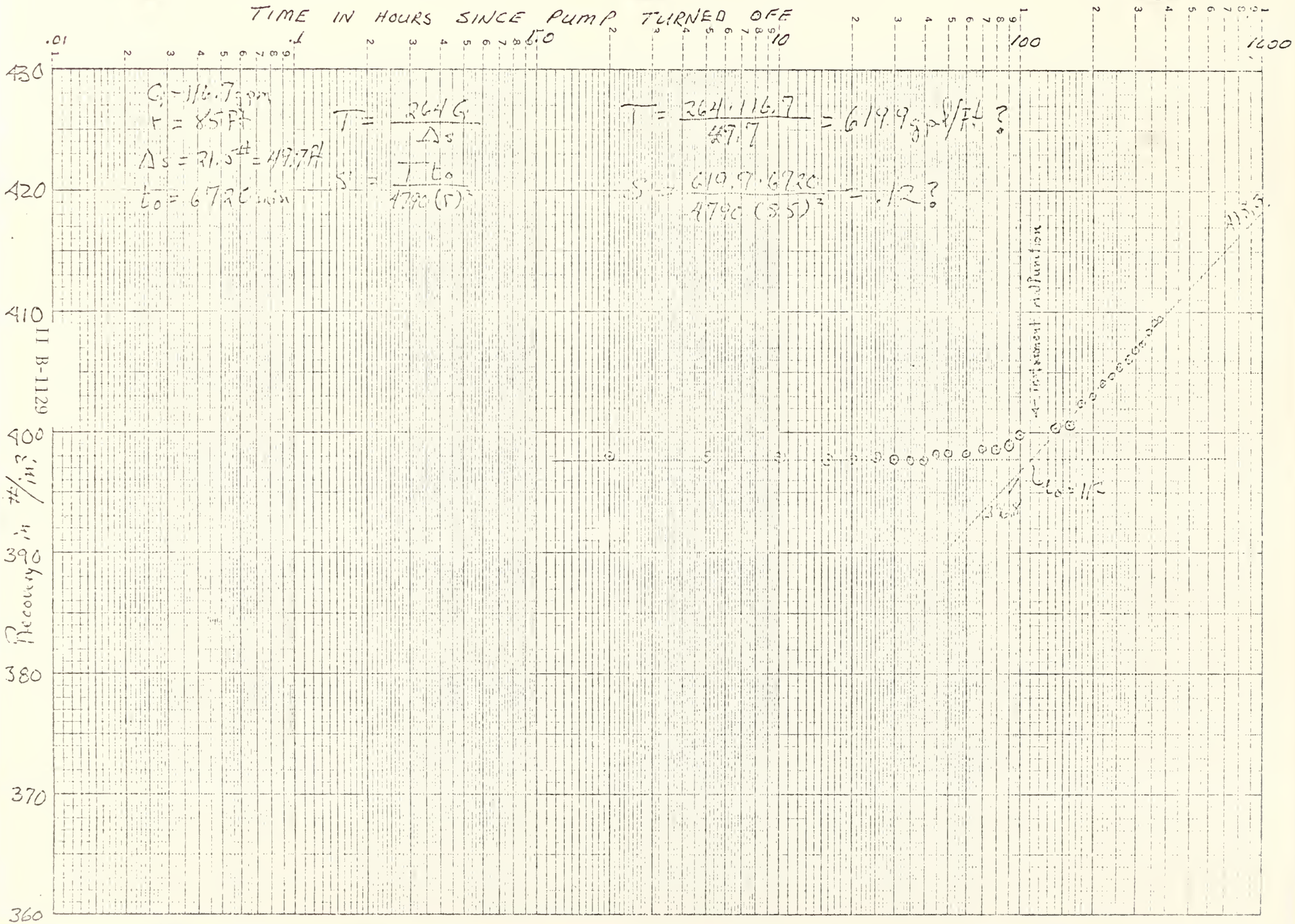
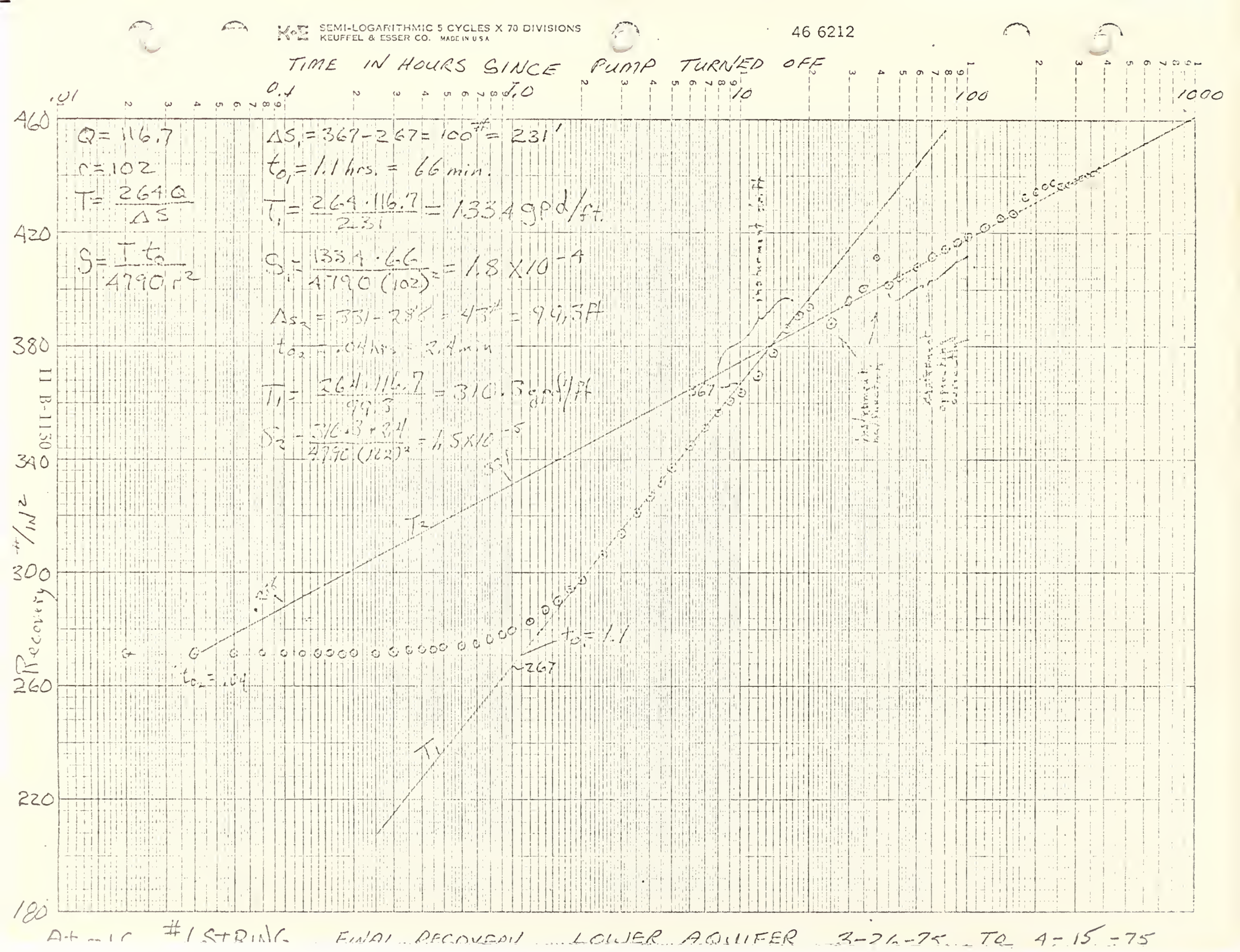


Fig. 1 FINAL RECOVERY LOWER AQUIFER 3-26-75 to 4-15-75

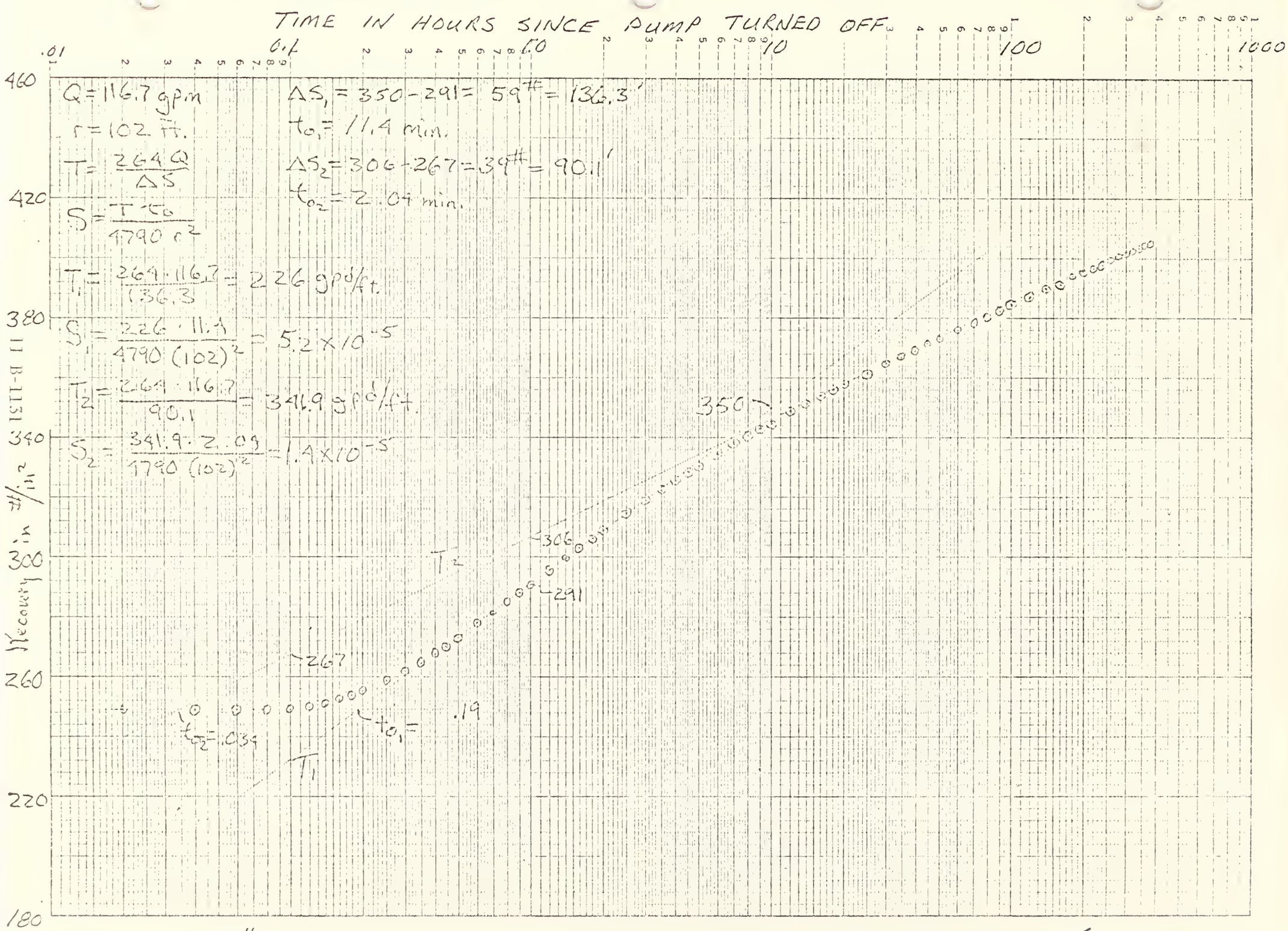
B-1127


K+E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 6212
Time in hours since pump turned off
.01
.1
1.0
10
100
1000
460
440
420
400
380
360
340
320
Recovery #/in²
r = 85 ft.
Q = 116.7 gpm
T = 264 Q / Δs
S = T t₀ / 4790 r²
Δs₁ = 382 − 342 = 40# = 92.4'
t₀₁ = 66 min.
T₁ = 264 · 116.7 / 92.4 = 333.4 gpd/ft.
S₁ = 333.4 · 66 / 4790 · (85)² = 6.4 × 10⁻⁴
Δs₂ = 419.5 − 383 = 36.5# = 84.32
t₀₂ = 51 min
T₂ = 264 · 116.7 / 84.3 = 365.4 gpd/ft
S₂ = 365.4 · 51 / 4790 (85)² = 5.3 × 10⁻⁴
383
382
T₁
T₂
t₀₂ = .85
t₀₁ = 1.1
342
419.5
II B-1128

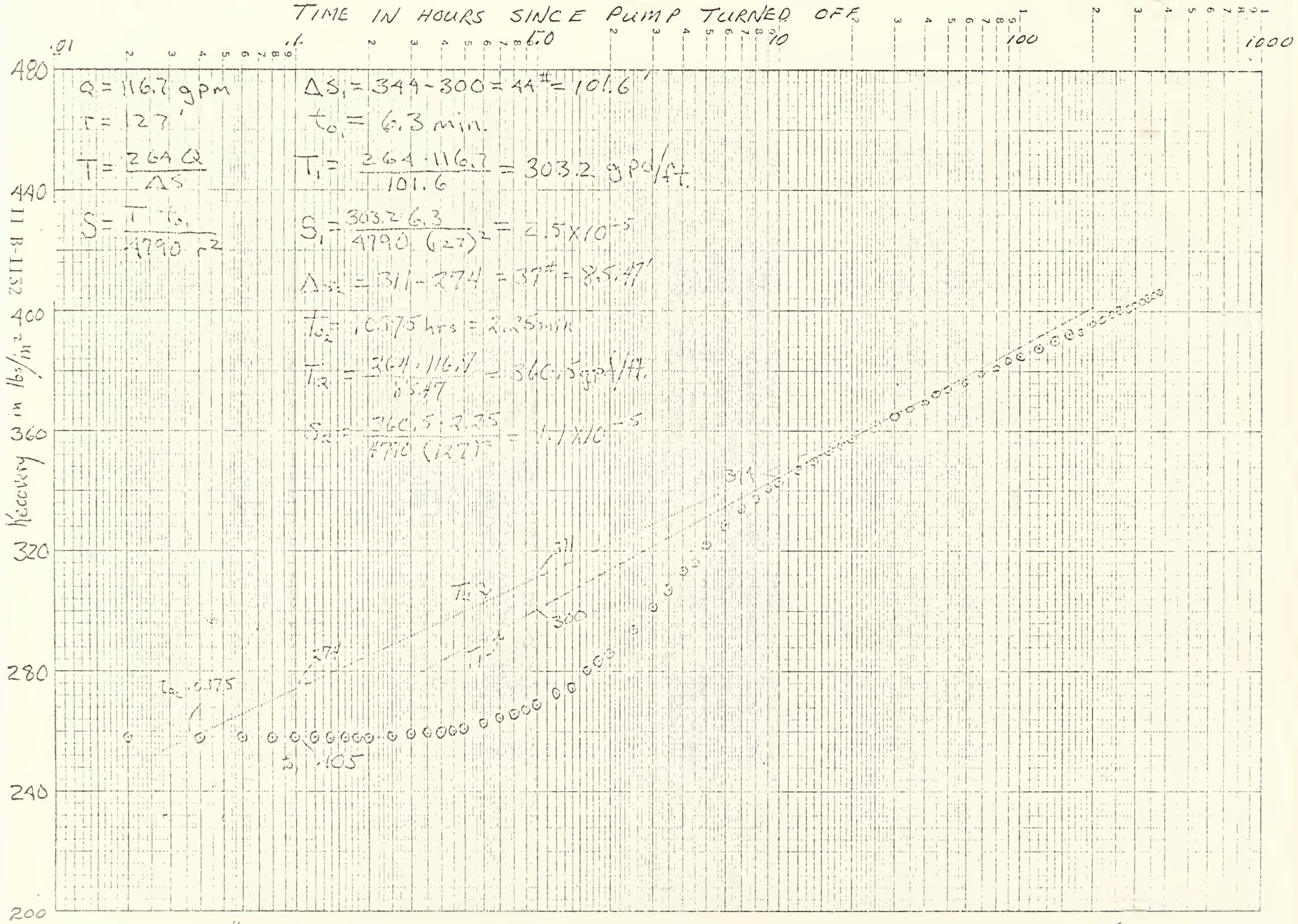

K+E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 6212
TIME IN HOURS SINCE PUMP TURNED OFF
.01
.1
1.0
10
100
1000
430
420
410
400
390
380
370
360
Recovery in #/in.²
G = 116.7 gpm
r = 85 ft
Δs = 21.5# = 49.7 ft
t₀ = 6720 min
T = 264 G / Δs
S = T t₀ / 4790 (r)²
T = 264 · 116.7 / 49.7 = 619.9 gpd/ft ?
S = 619.9 · 6720 / 4790 (85)² = .12 ?
← Instrument malfunction
t₀ = 112
II B-1129

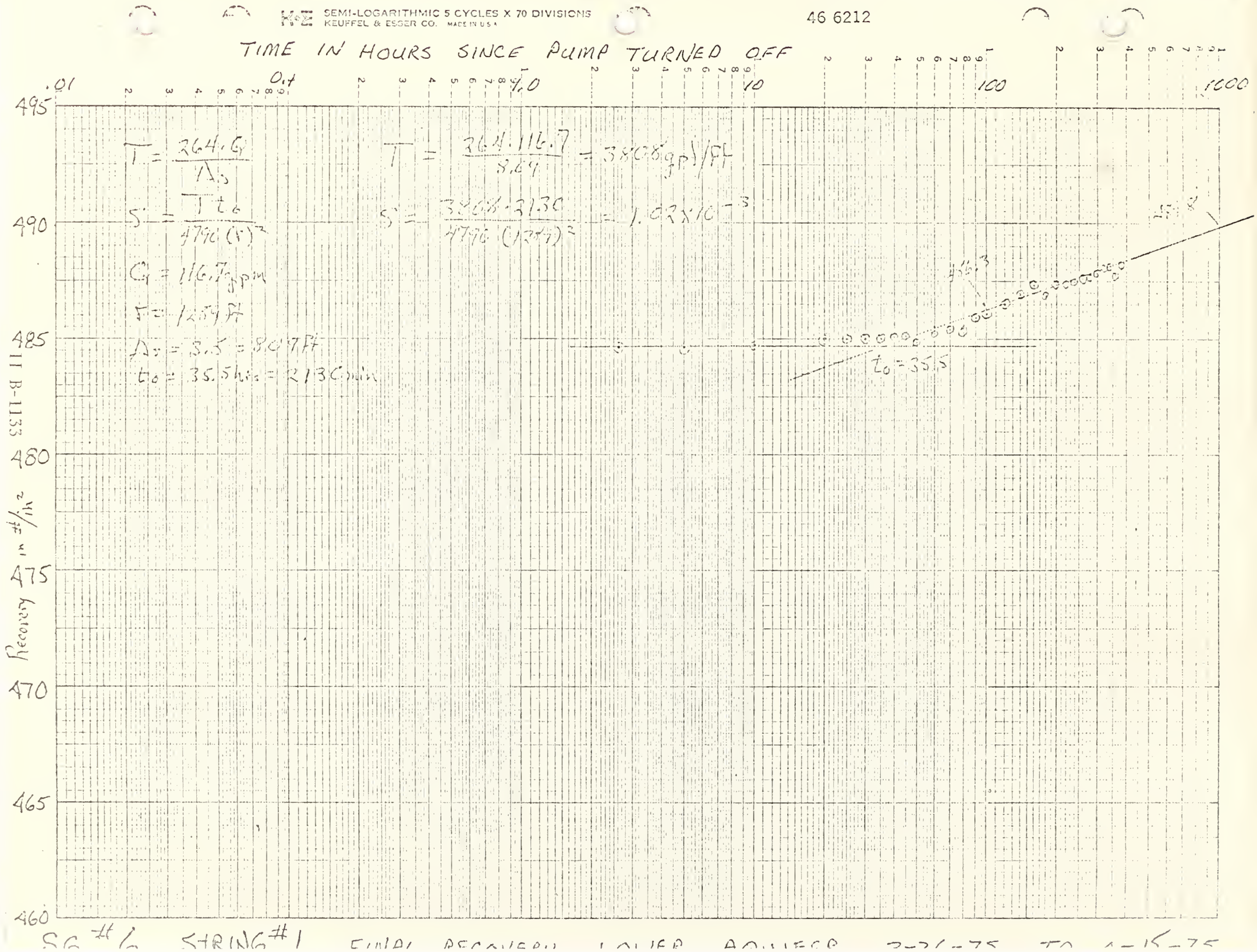


At - 1C #1 STRING FINAL RECOVERY LOWER AQUIFER 3-26-75 TO 4-15-75



At-1C STRING #7 FINAL RECOVERY LOWER AQUIFER 3-26-75 TO 4-15-75

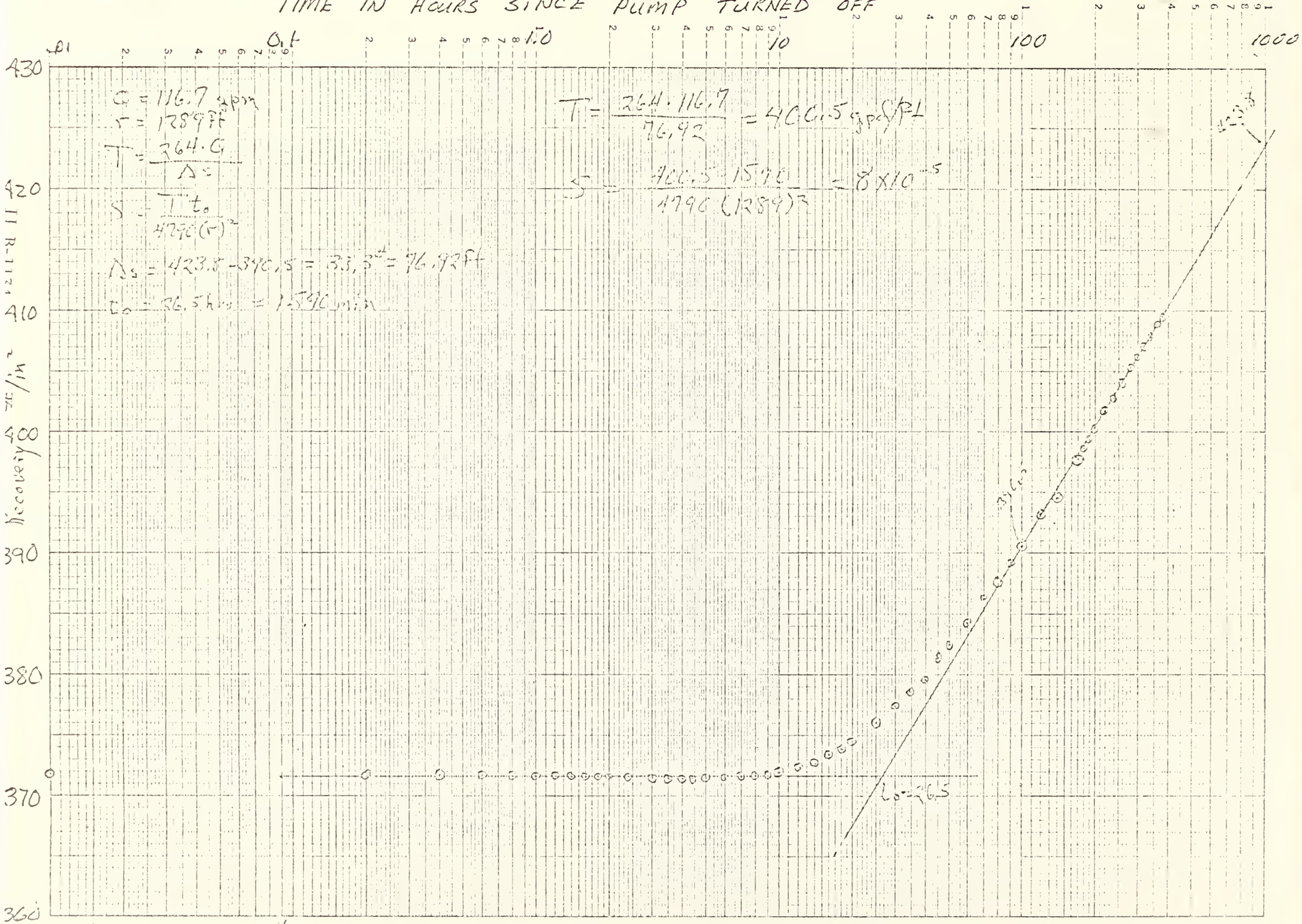

K+E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 6212
TIME IN HOURS SINCE PUMP TURNED OFF
.01
.1
1.0
10
100
1000
480
440
400
360
320
280
240
200
Recovery in lbs/in²
Q = 116.7 gpm
r = 127'
T = 264 Q / ΔS
S = T t₀₁ / 4790 r²
ΔS₁ = 344 - 300 = 44# = 101.6'
t₀₁ = 6.3 min.
T₁ = 264 · 116.7 / 101.6 = 303.2 gpd/ft.
S₁ = 303.2 · 6.3 / 4790 (127)² = 2.5 x 10⁻⁵
ΔS₂ = 311 - 274 = 37# = 85.47'
t₀₂ = .0375 hrs = 2.25 min
T₂ = 264 · 116.7 / 85.47 = 360.5 gpd/ft.
S₂ = 360.5 · 2.25 / 4790 (127)² = 1.1 x 10⁻⁵
311
311
300
274
t₀₂ .0375
t₀₁ .105
II B-1132
At-1D STRING #2 FINAL RECOVERY LOWER AQUIFER 3-26-75 TO 4-15-75


K+E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 6212
TIME IN HOURS SINCE PUMP TURNED OFF
.01
0.1
1.0
10
100
1000
495
490
485
480
475
470
465
460
Recovery in #/in²
T = 264·Q / Δs
S = T t₀ / 4790 (r)²
Q = 116.7 gpm
r = 1259 ft
Δs = 3.5 = 8.07 ft
t₀ = 35.5 hrs = 2130 min
T = 264·116.7 / 8.09 = 3808 gpd/ft
S = 3808·2130 / 4790 (1259)² = 1.02×10⁻³
t₀ = 35.5
II B-1133
SG #6 STRING #1 FINAL RECOVERY LOWER AQUIFER 3-26-75 TO 4-15-75

K+E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

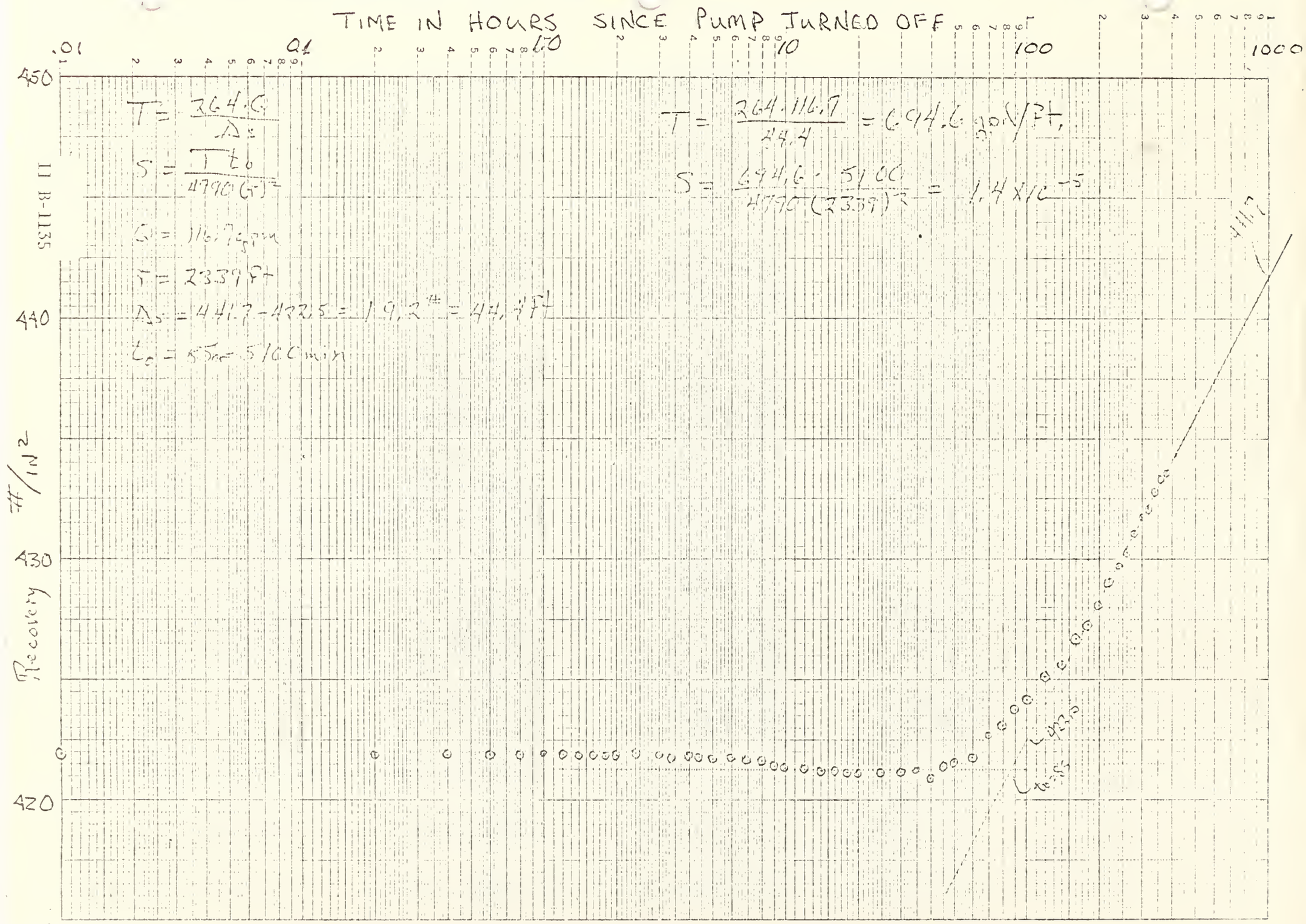
46 6212

TIME IN HOURS SINCE PUMP TURNED OFF



SC #1 STRING #7 FINAL RECOVERY LOWER AQUIFER

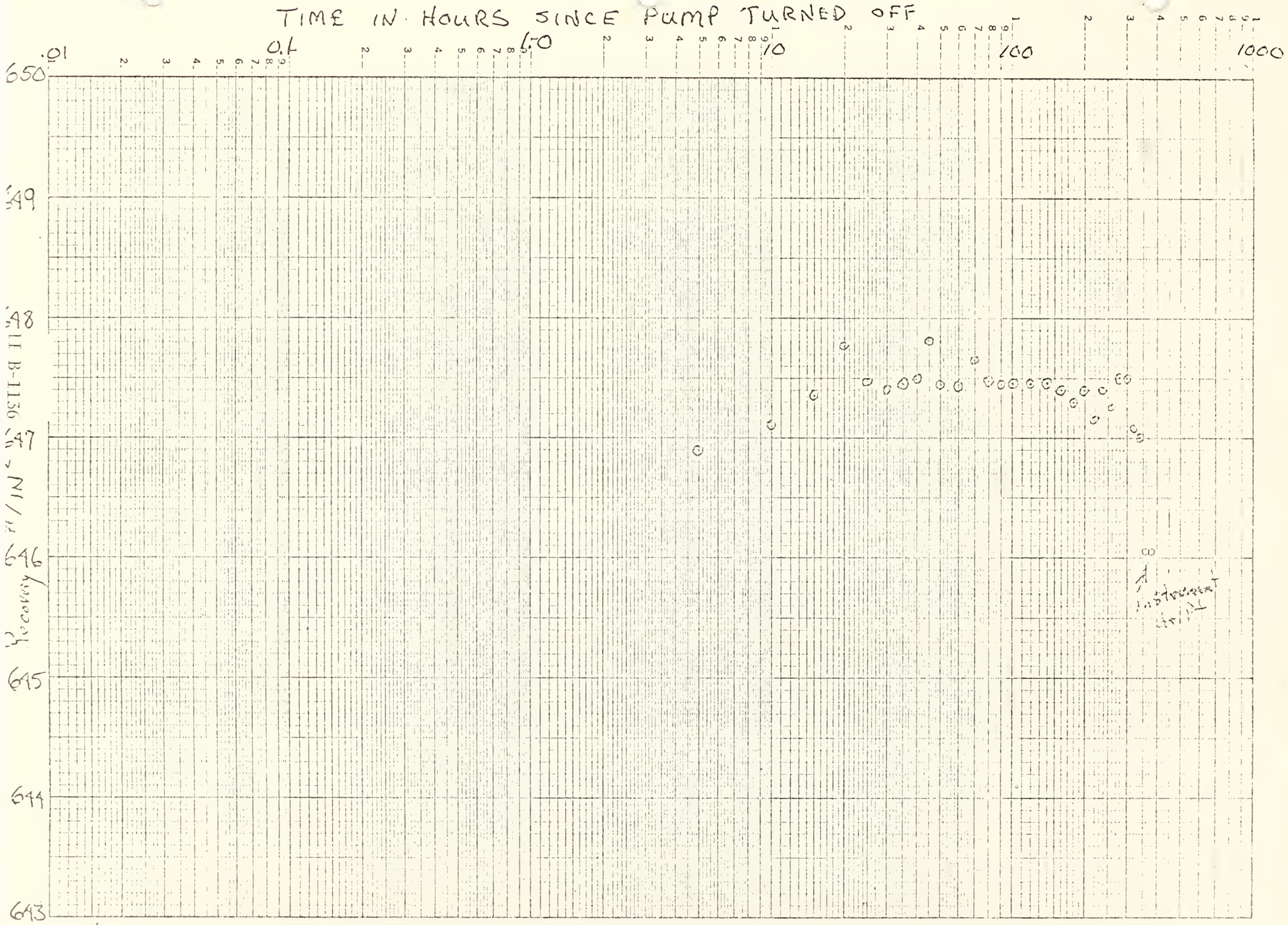
K+E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 6212



RG#10 STRING#1 FINAL RECOVERY LOWER AQUIFER 3-26-75 TO 4-15-75

K+E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

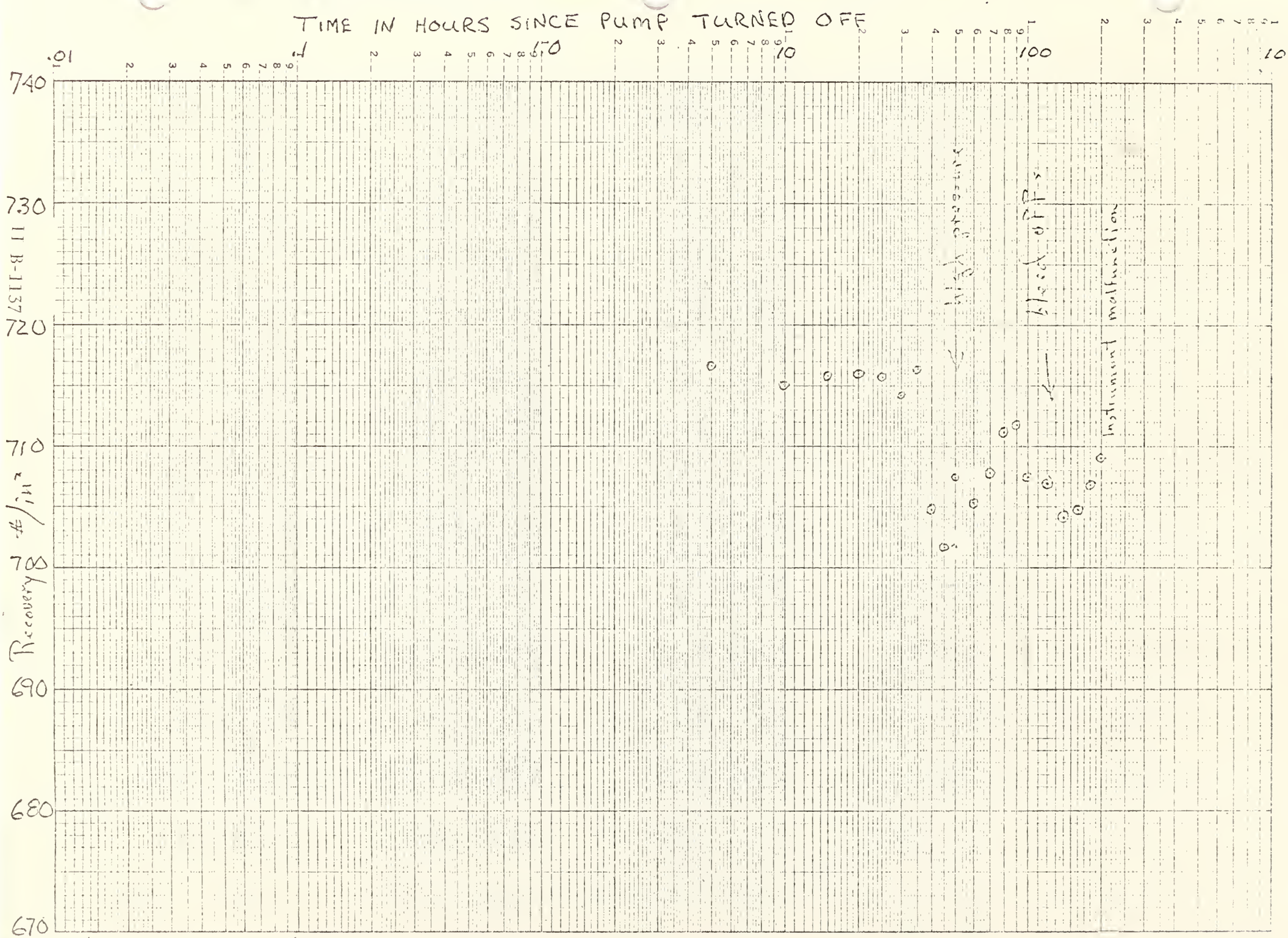
46 6212



CR #1A <STRING #> FINAL RECOVERY LOWER AQUIFER 3-26-75 TO 4-15-75

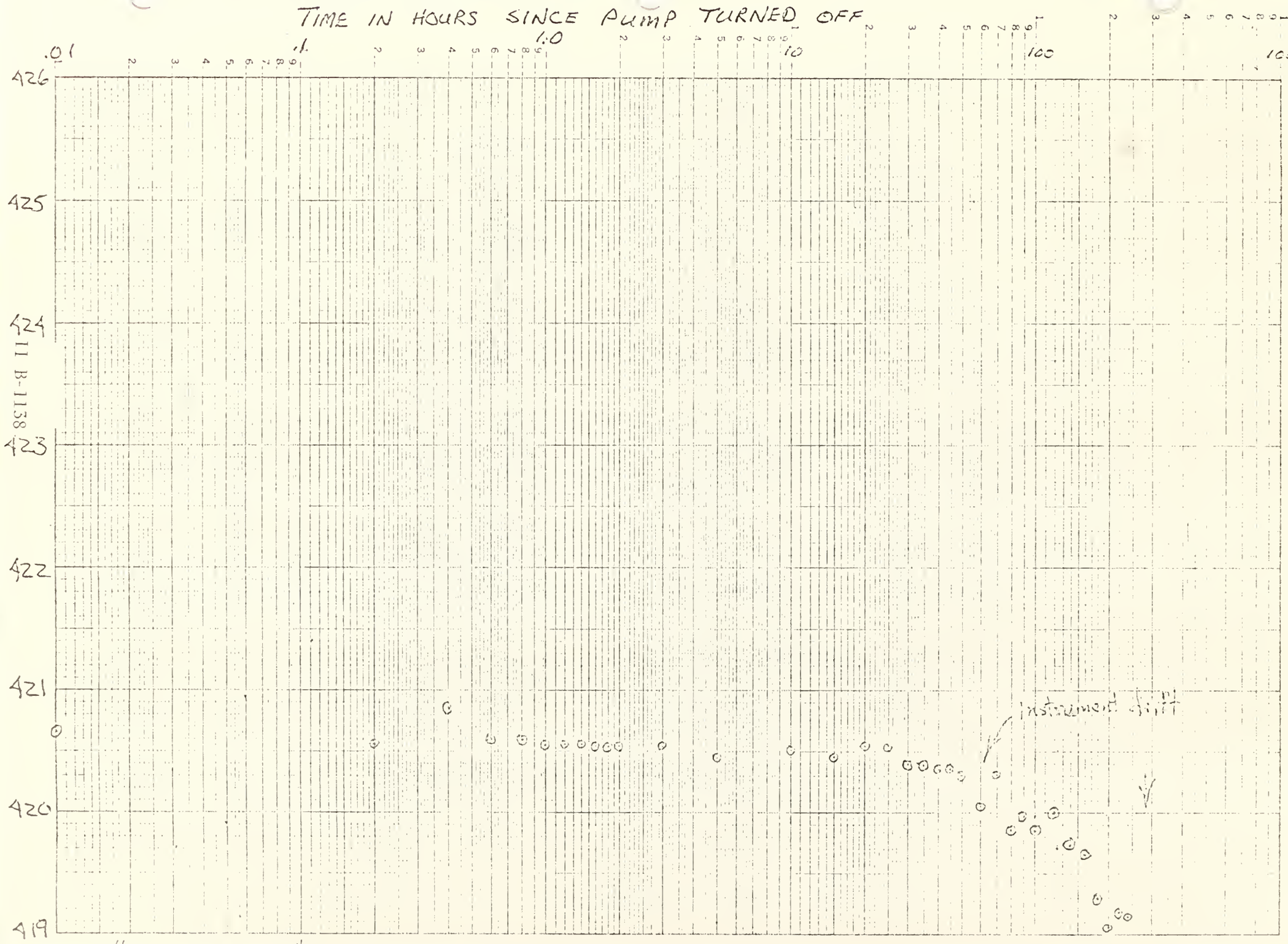
K+E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 6212



Sr # 11 STRING # 1 FINAL RECOVERY LOWER AQUIFER 7-26-75 TO 8-15-7

K&E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 6212



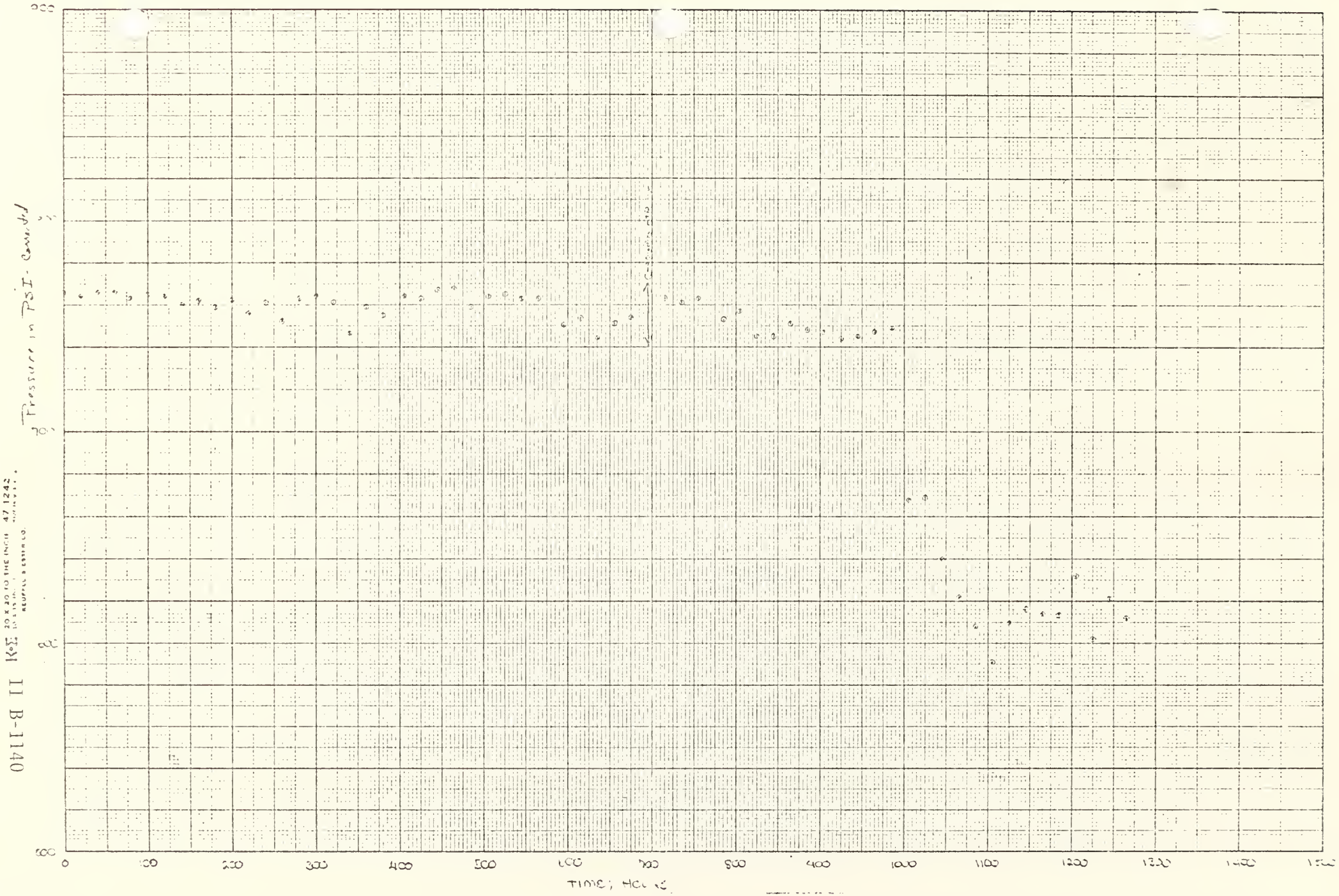
II B-1158

SC #11 STRING #2 FINAL RECOVERY LOWER AQUIFER 3-26-75 TO 4-15-75

LOWER AQUIFER PUMP TEST

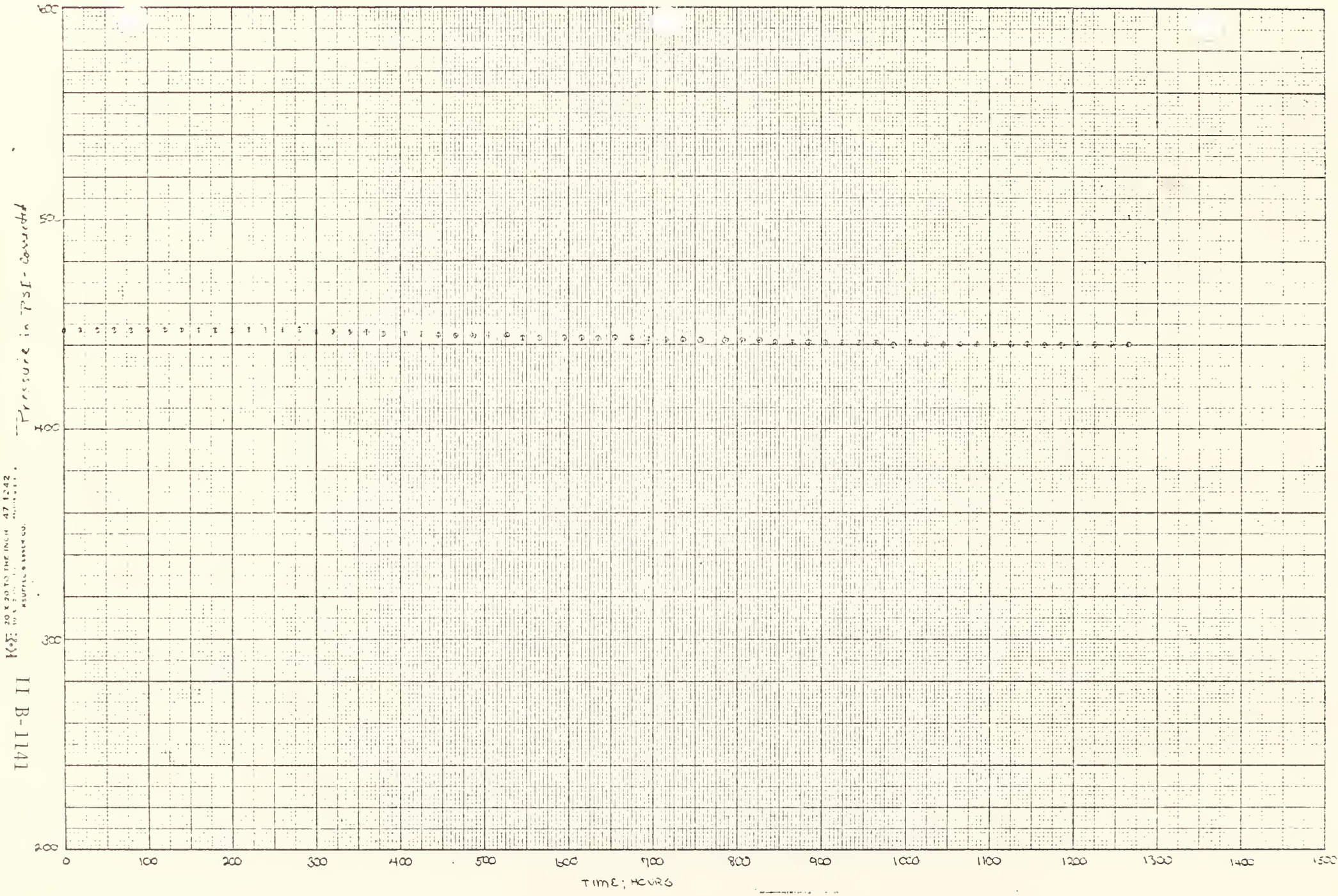
CORRECTED PRESSURE CURVES

LOWER AQUIFER PUMP TEST: 56-11 STRING #1



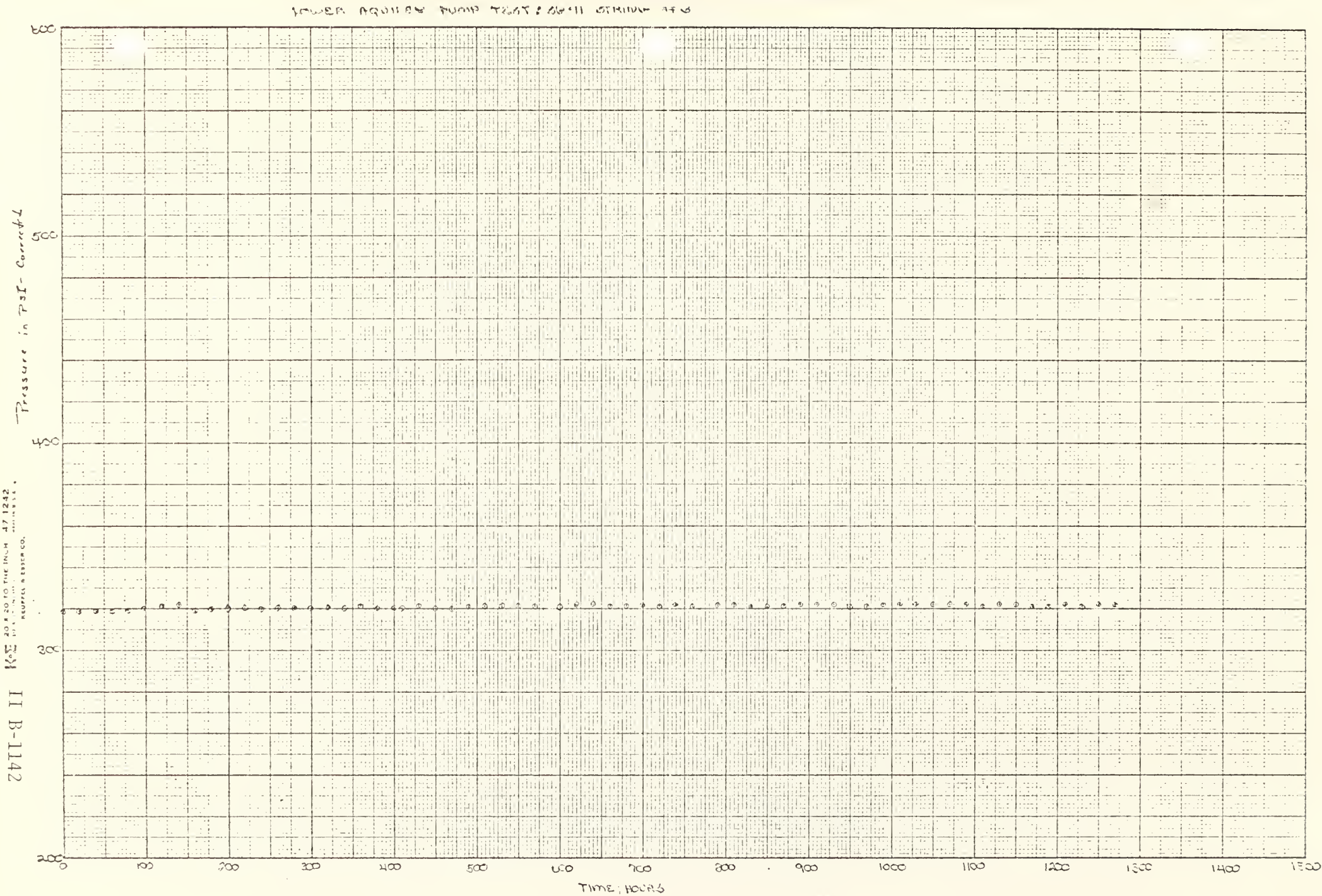
K+E 20 X 20 TO THE INCH 47 1242
KEUFFEL & ESSER CO.

LOWER AQUIFER PUMP TEST : 56-11 STRIPPER # 2



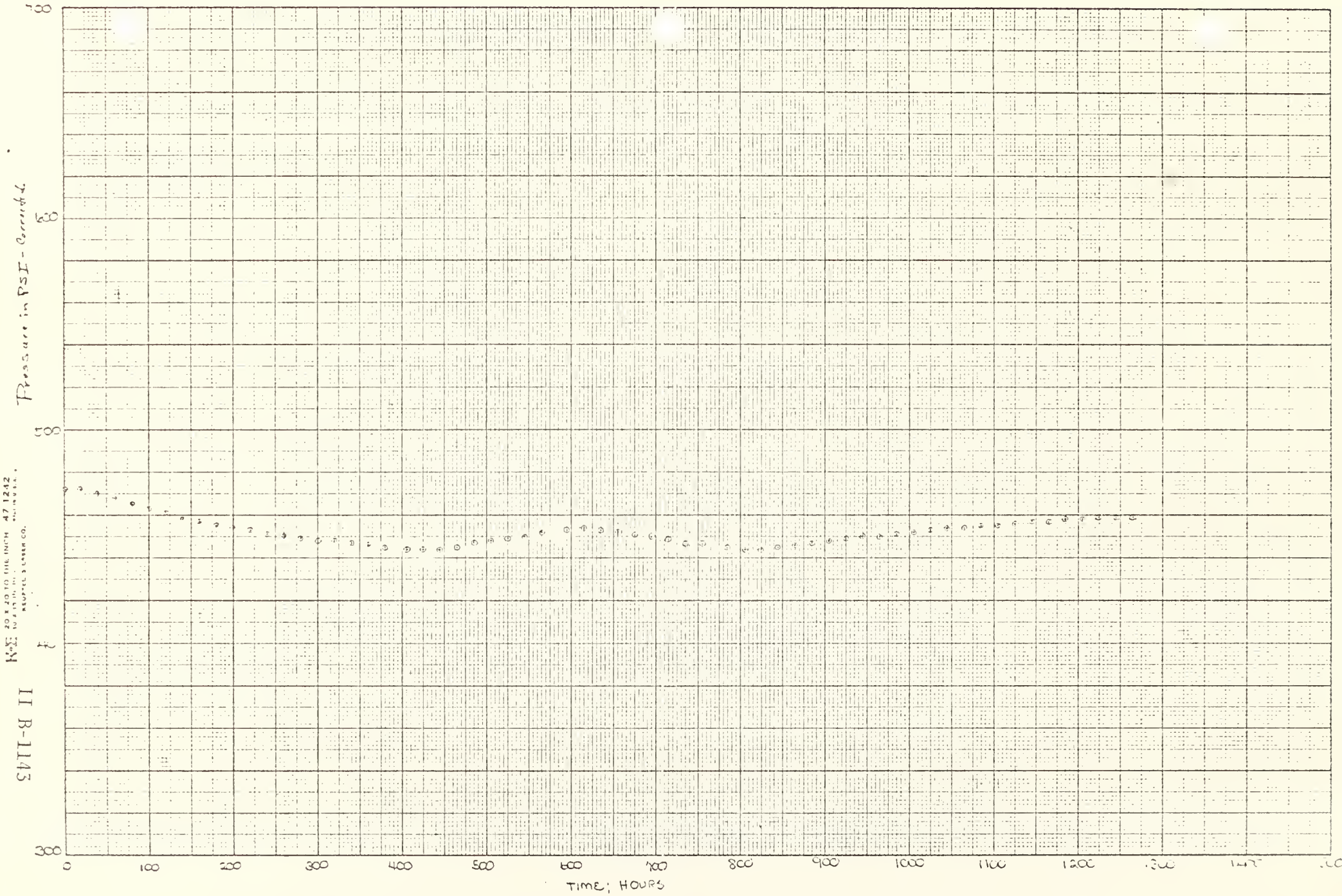
K+E 20 X 20 TO THE INCH 47 1242
10 X 10 TO THE INCH
KEUFFEL & ESSER CO.

LOWER AQUIFER PUMP TEST: 56-11 STRIDE #3

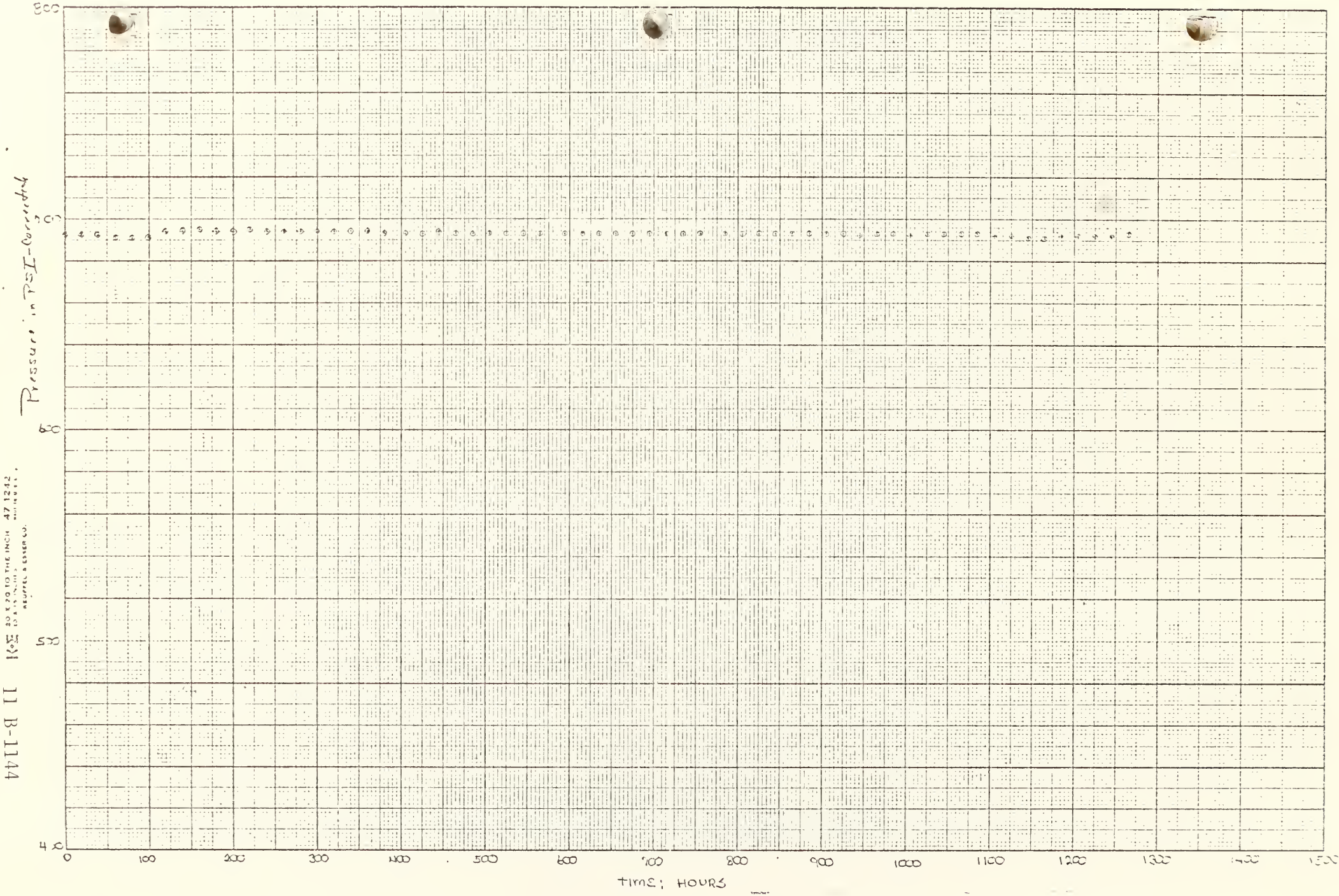


K&E 20 X 20 TO THE INCH 47 1242
KEUFFEL & ESSER CO.

LOWER AQUIFER HORN TEST ; 56-10 STRING #1



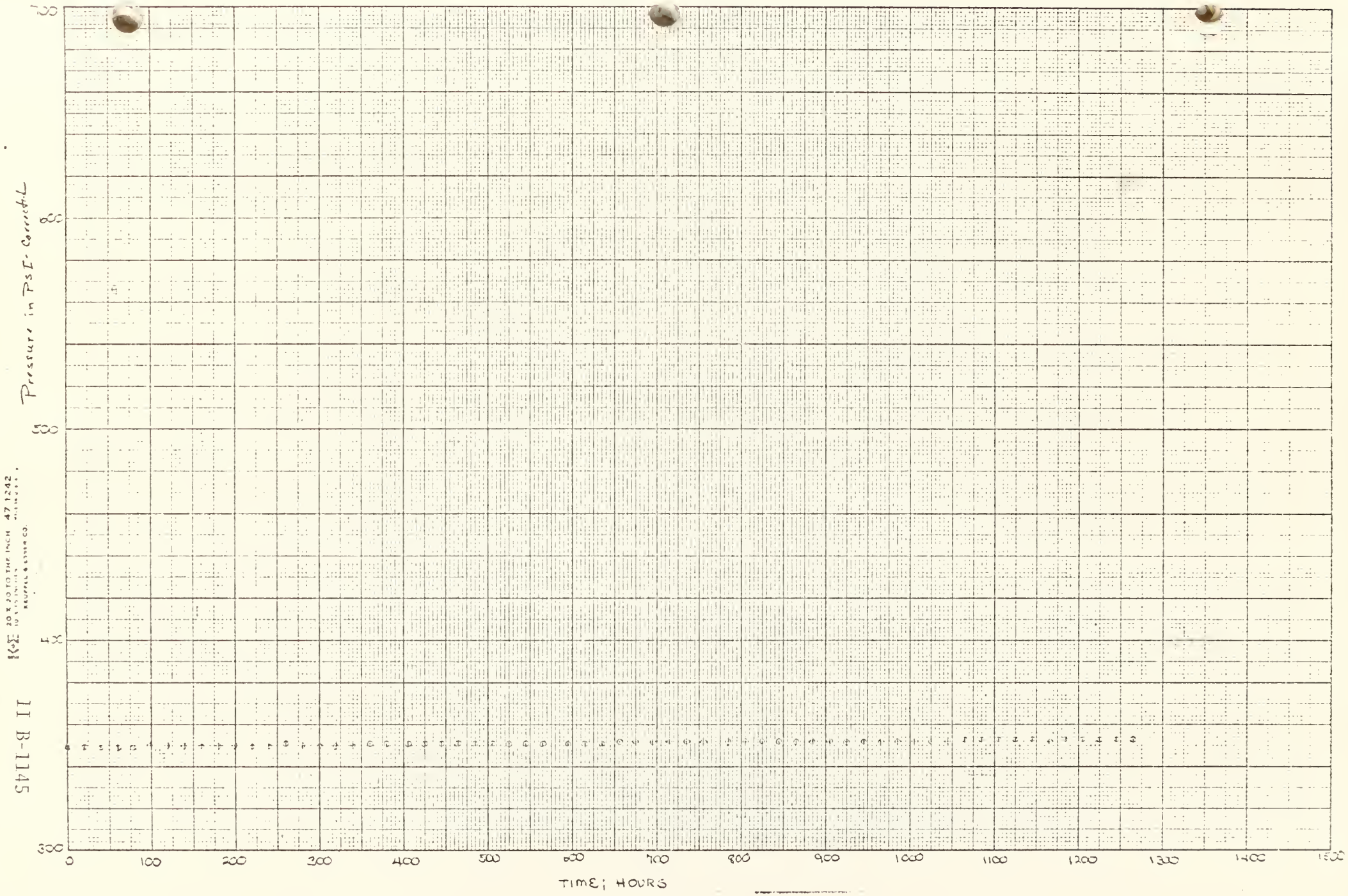
LOWER AQUIFER PUMP TEST : SW-10 STRING # 2



K&E 20 X 20 TO THE INCH 47 1242
KEUFFEL & ESSER CO.

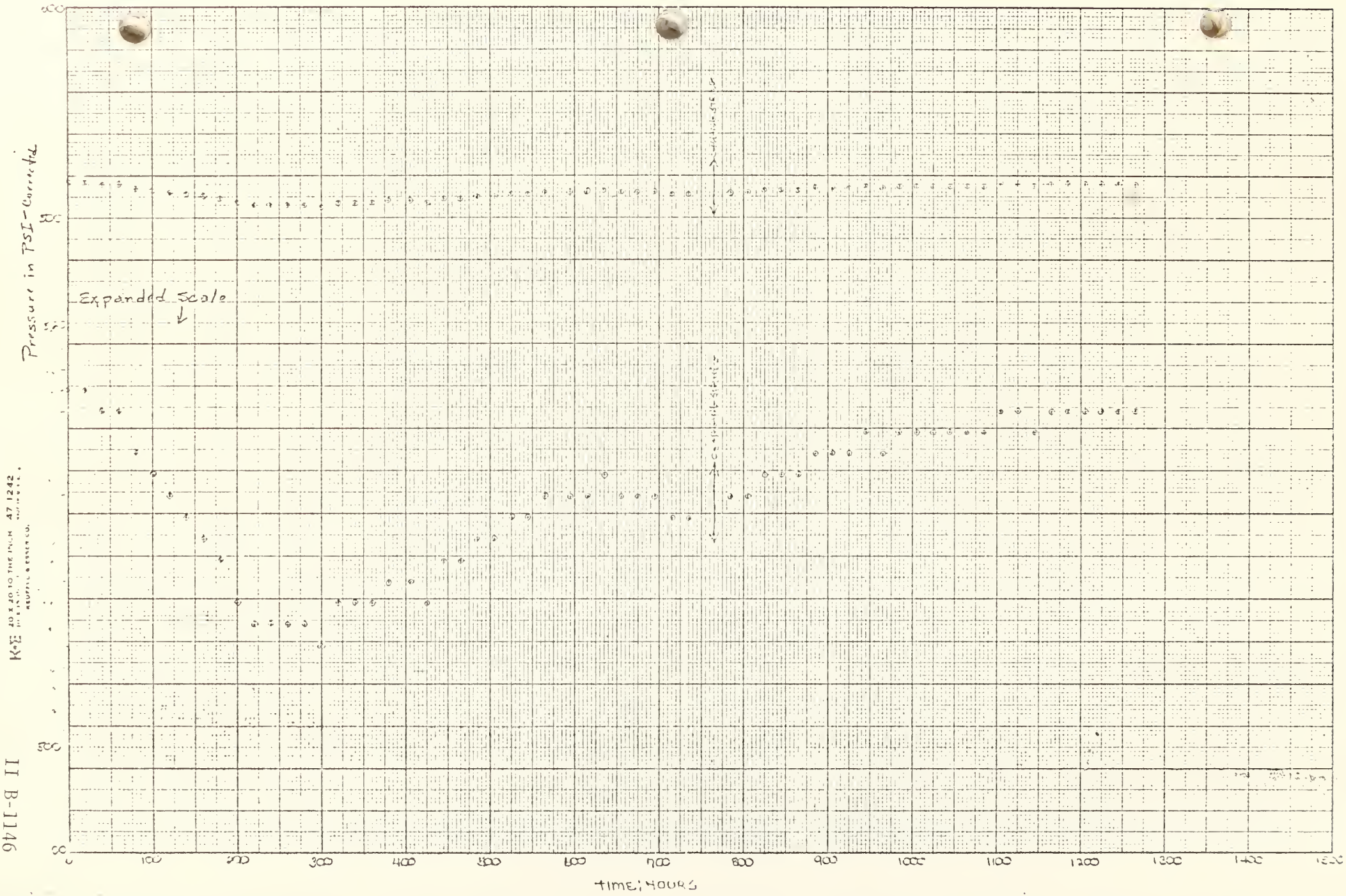
11 B-1144

LOWER AQUIFER PUMP TEST: SG-10 SPRING #3



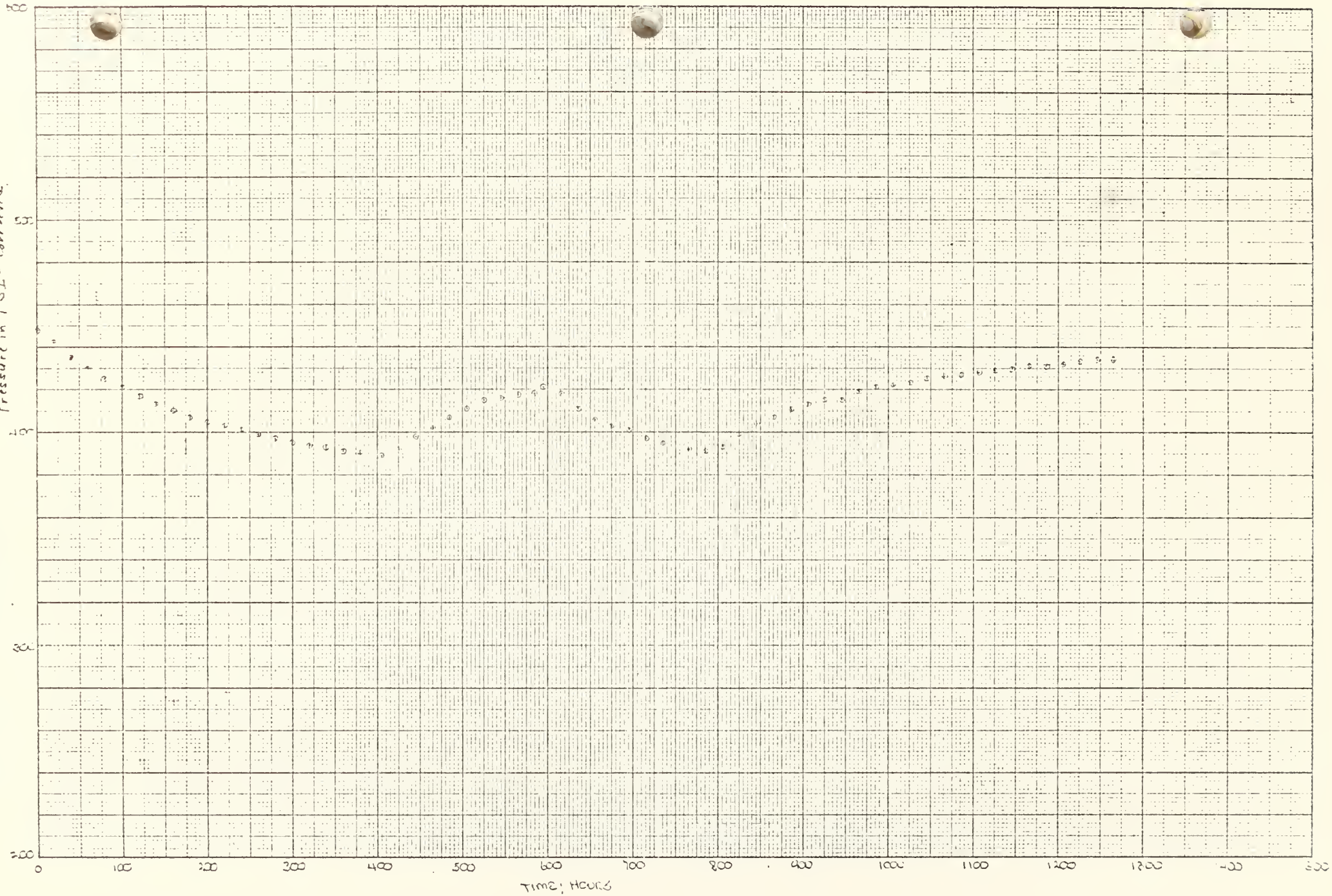
K+E 20 X 20 TO THE INCH 47 1242
10 X 10 INCHES
KEUFFEL & ESSER CO.

II B-1145



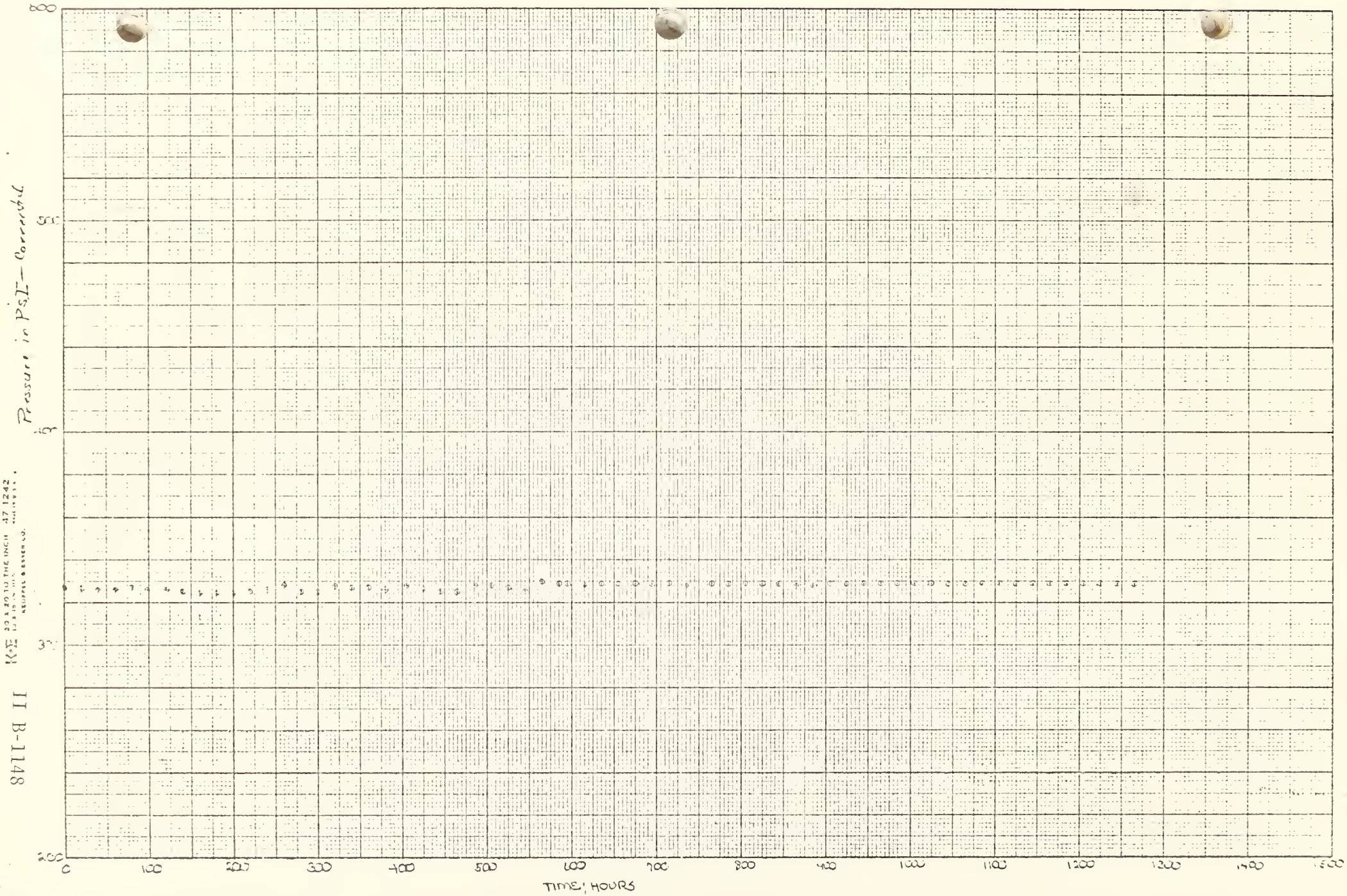
K+E 20 X 20 TO THE INCH 47 1242

LOWER AQUIFER PUMP

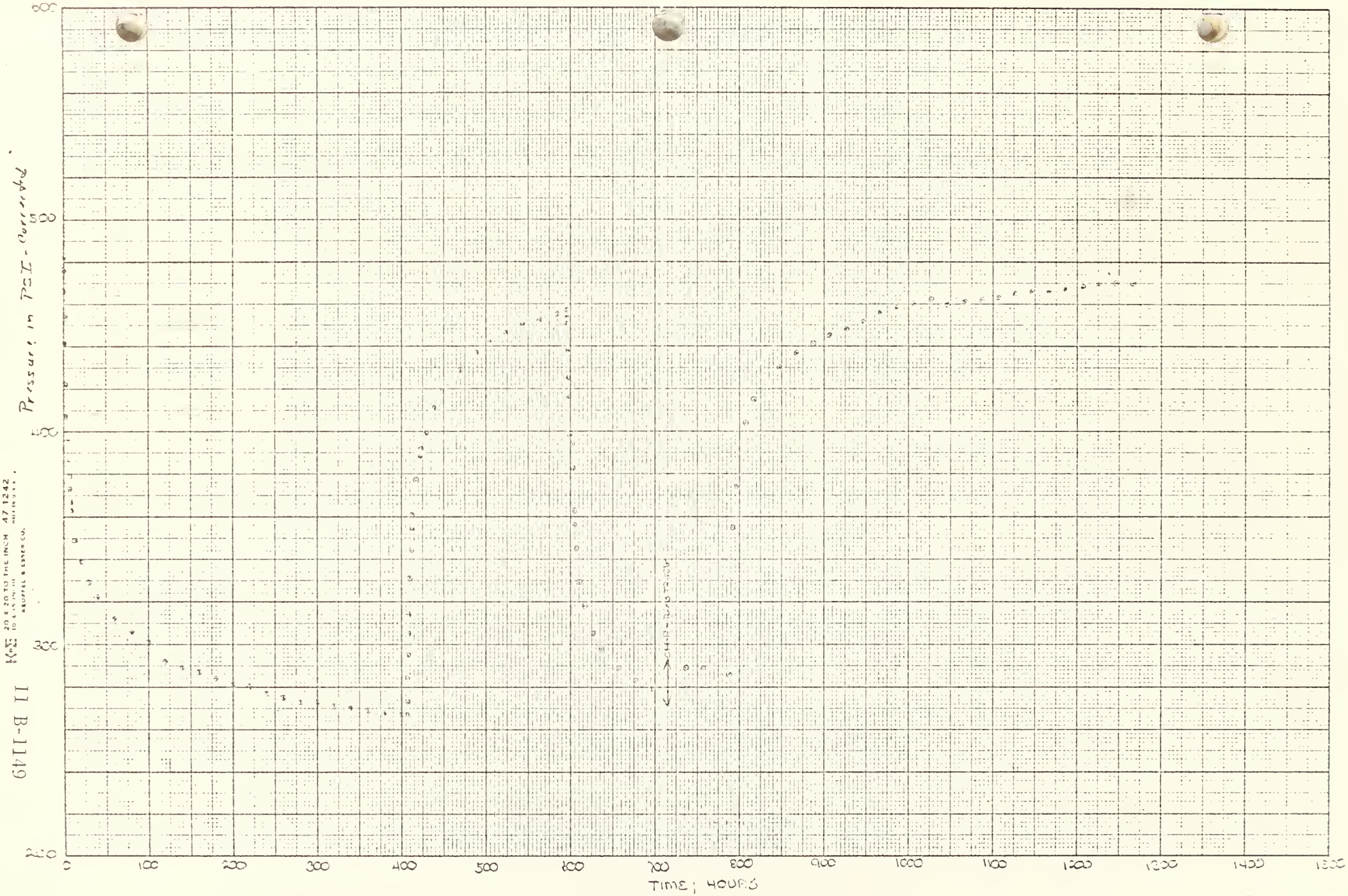


K+E 20 X 20 TO THE INCH 47 1242
10 X 10 TO THE INCH
KEUFFEL & ESSER CO.

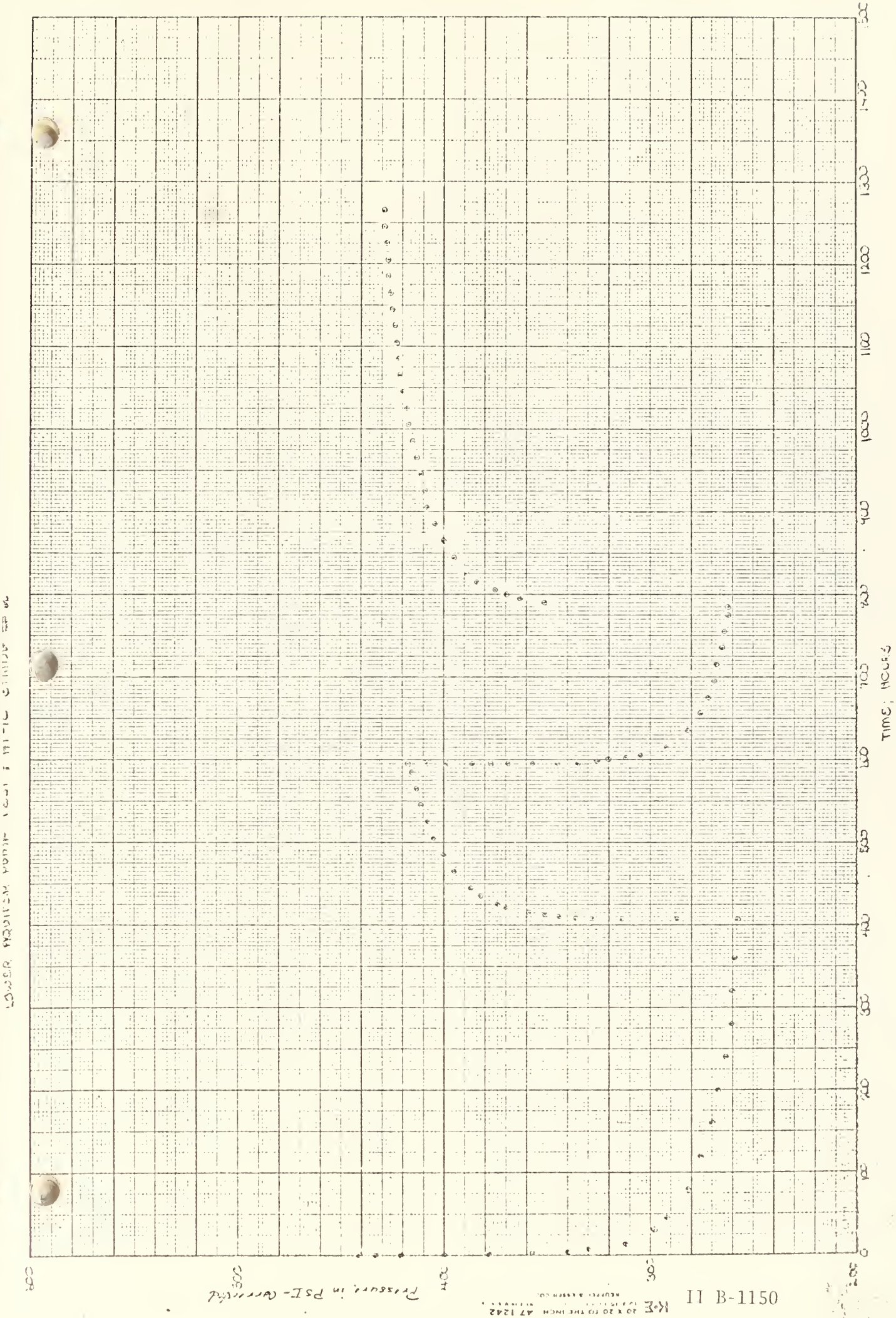
LOWER AQUIFER PUMP TEST: 56-6 STRING #3



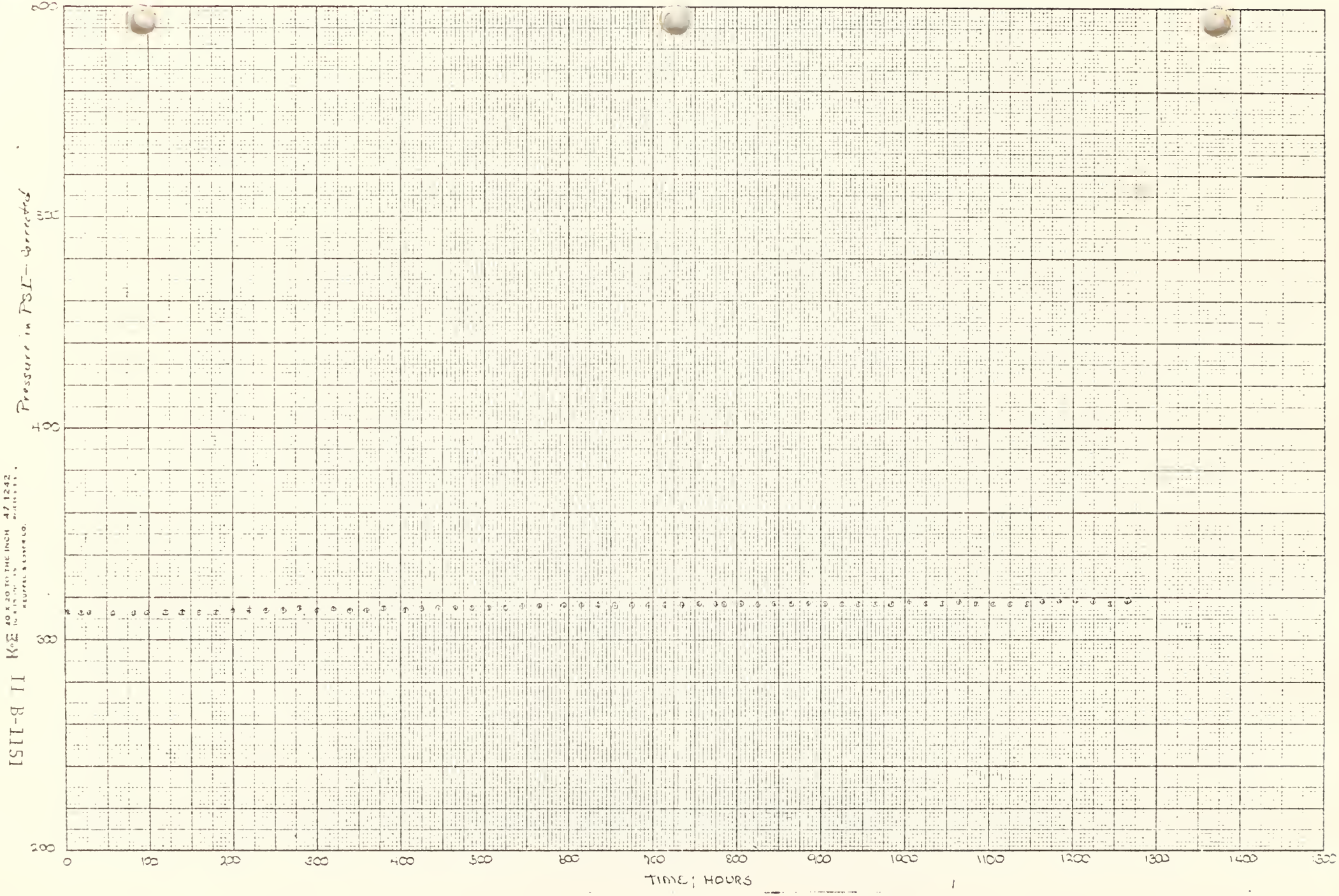
K+E 10 X 10 TO THE INCH 47 1242



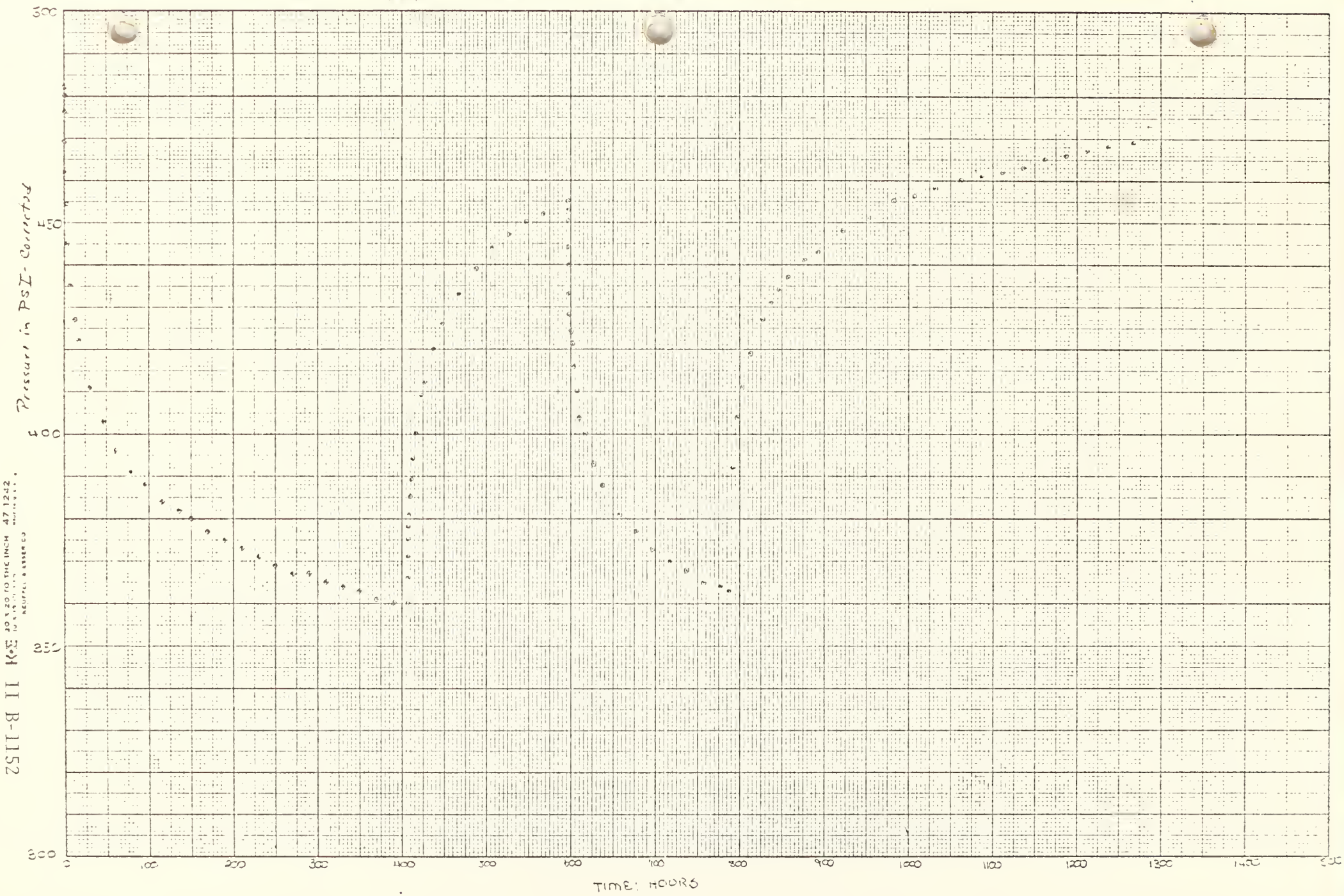
K&E 20 X 20 TO THE INCH 47 1242
10 X 10 TO THE INCH
KEUFFEL & ESSER CO.


TIME, HOURS
Pressure, in PSI - Corrected
K+E 10 X 20 TO THE INCH 47 1242
KEUFFEL & ESSER CO.

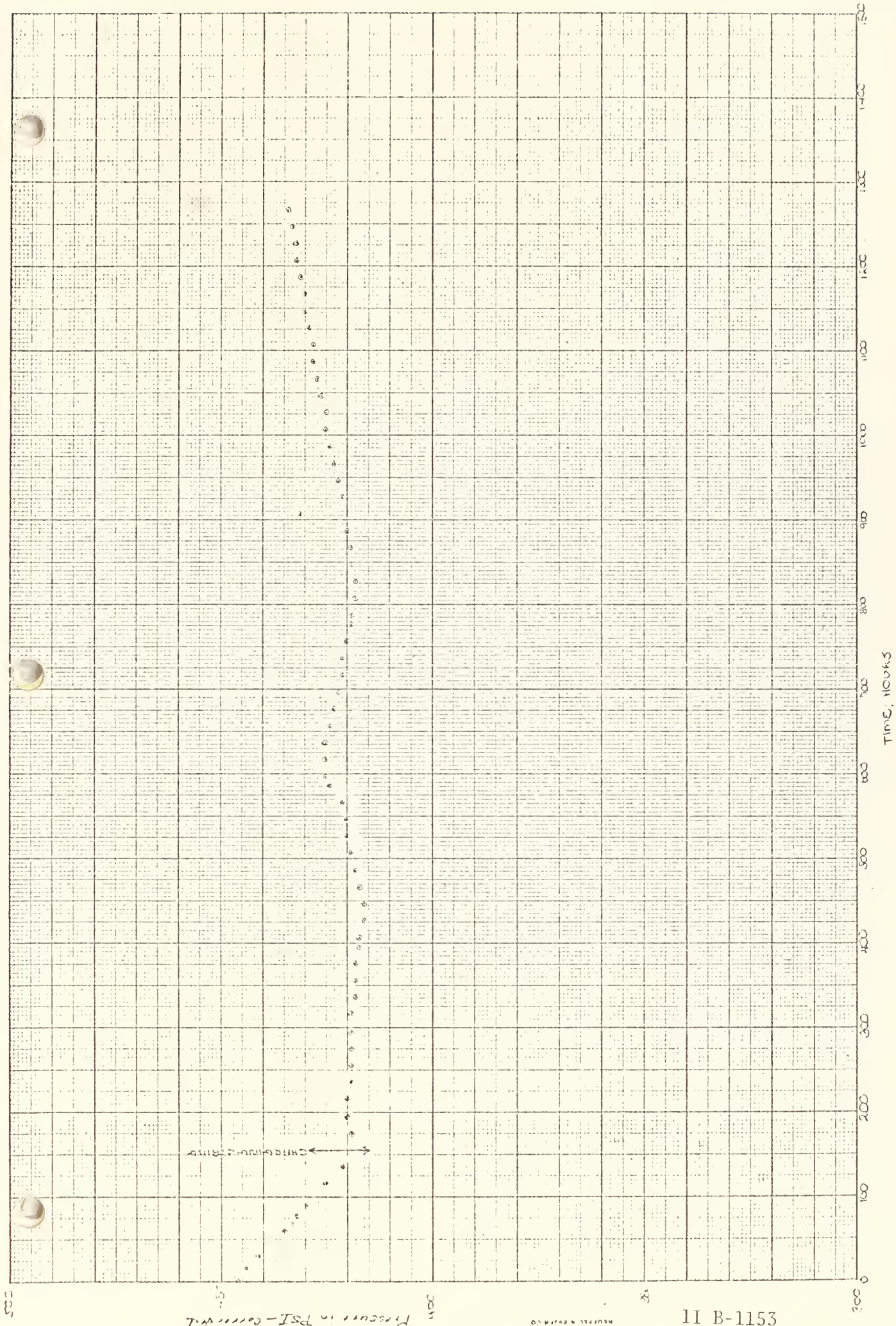
Lower Aquifer Pump Test: At-1C String #3



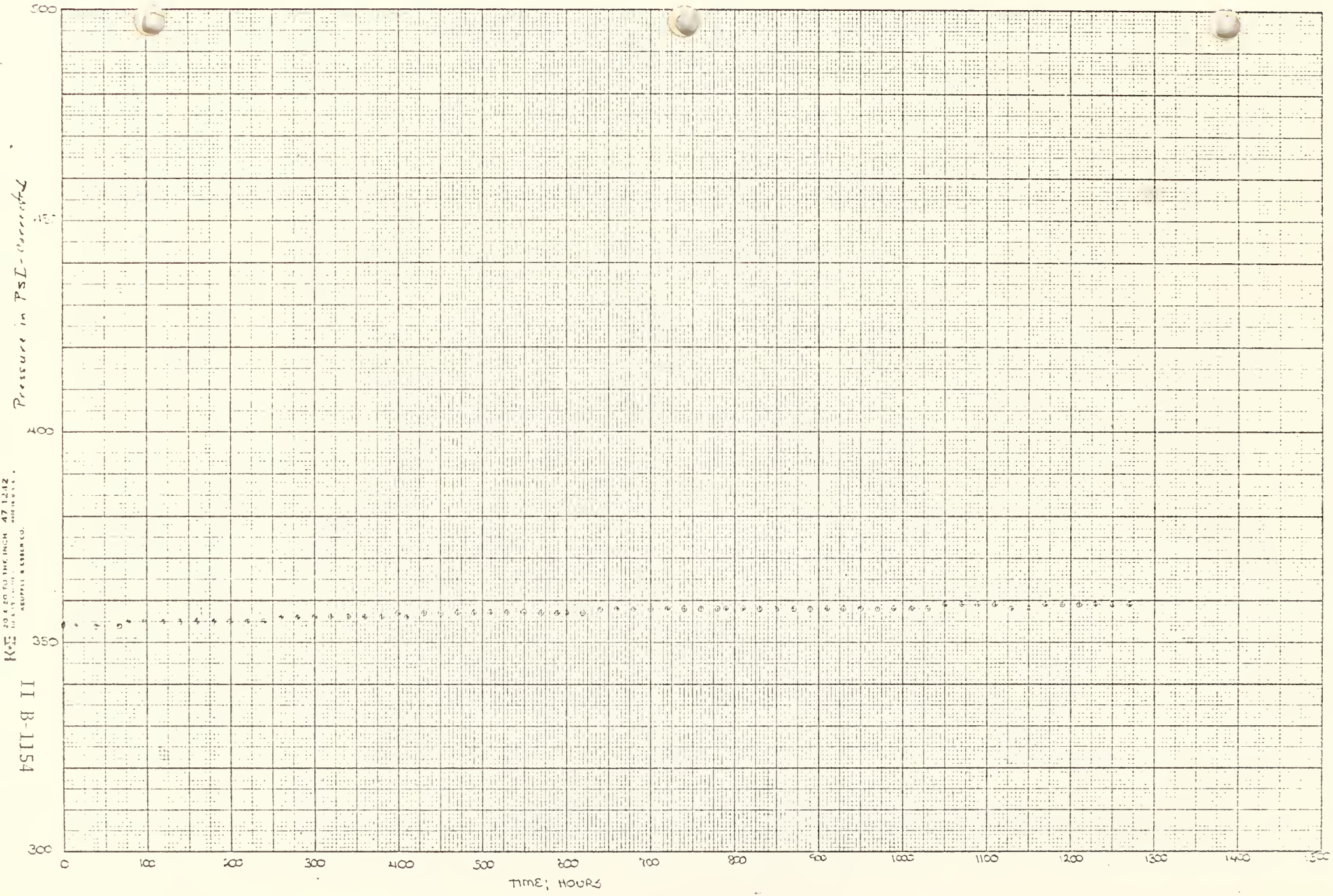
LOWER AQUIFER PUMP TEST: AT-1A STATION #



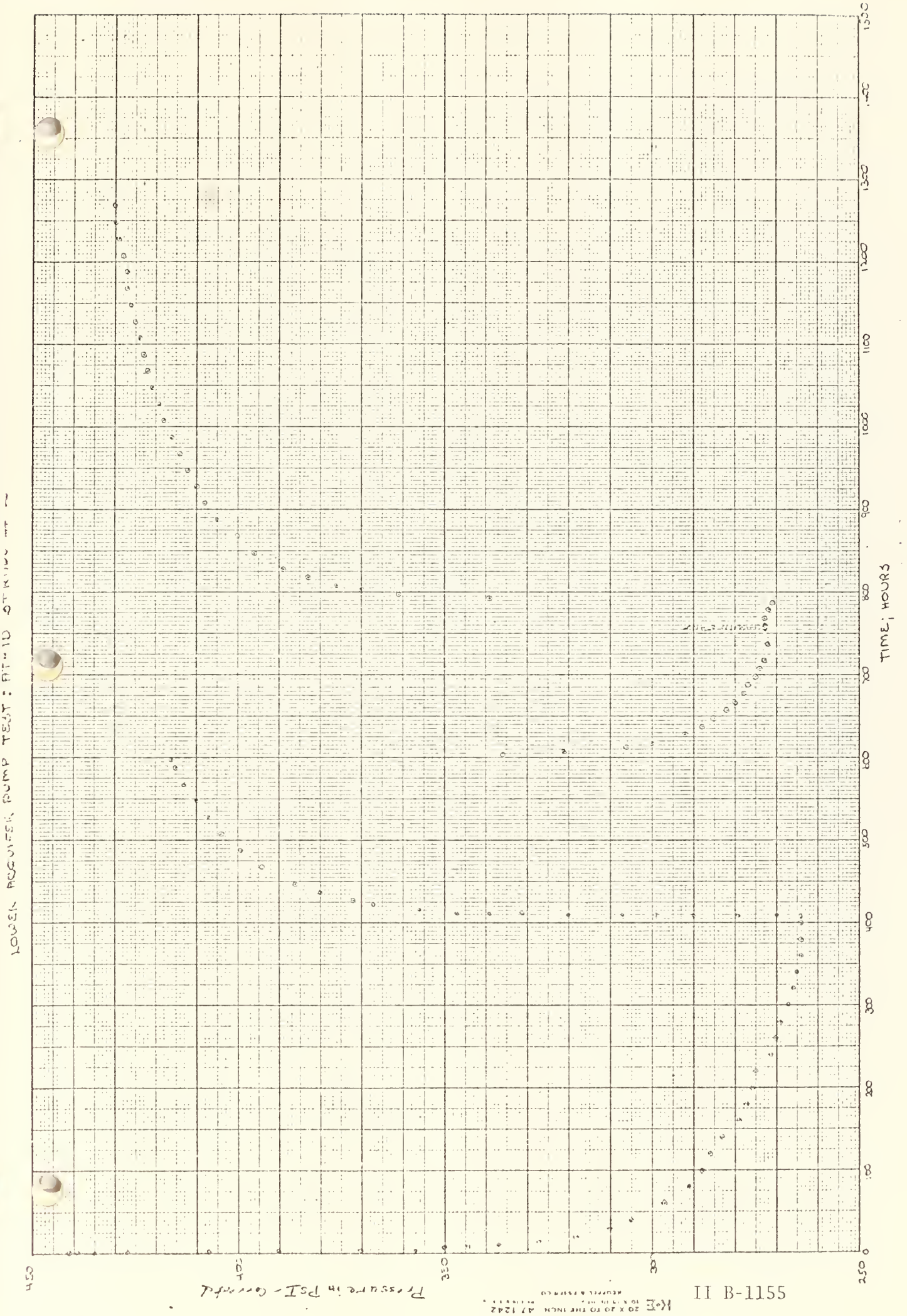
K+E 20 X 20 TO THE INCH 47 1242
KEUFFEL & ESSER CO.


TIME, HOURS
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
Pressure in PSI - Corrected
CHARGING STRIP

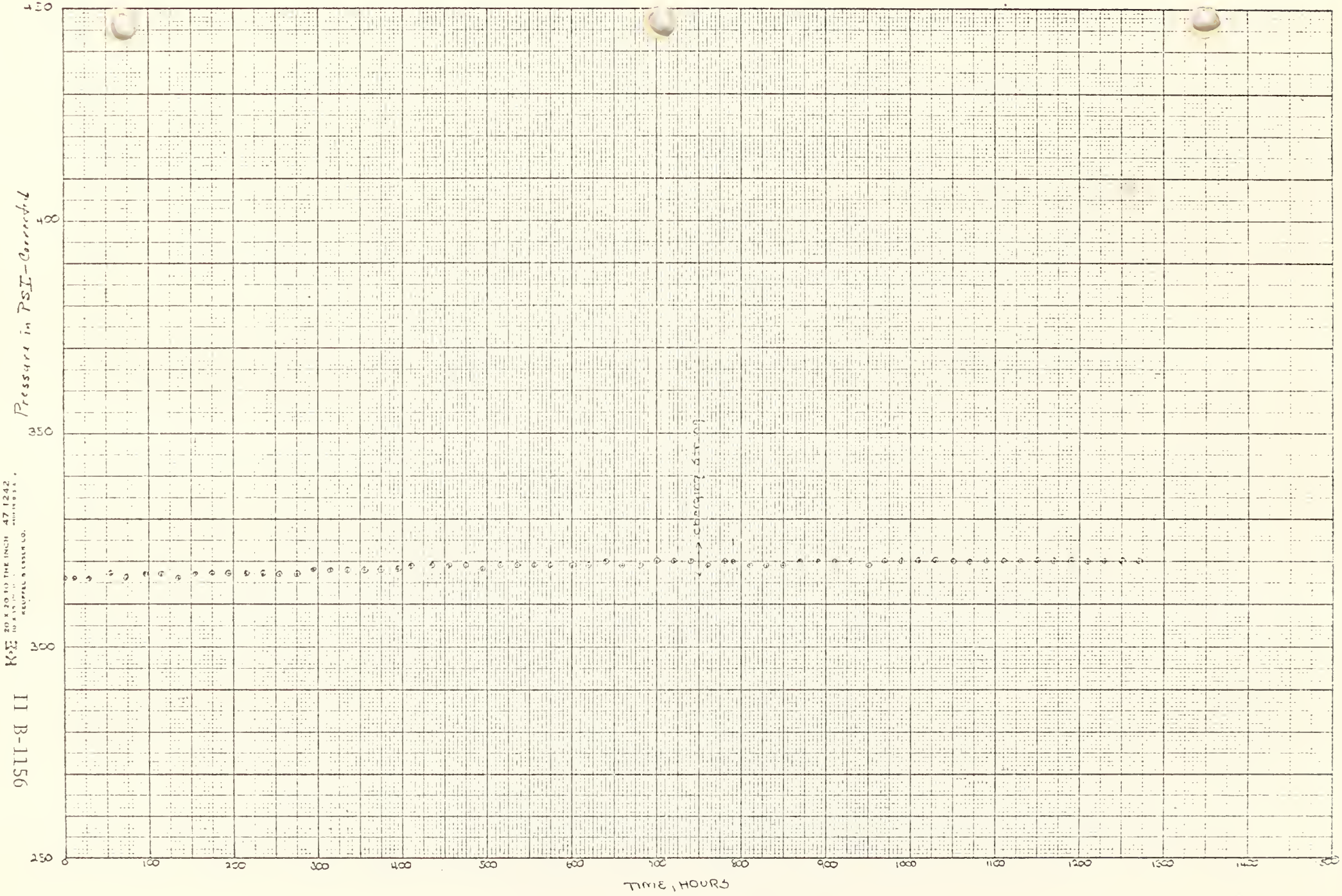
LOWER AQUIFER PUMP TEST: AT-1A STRING #3



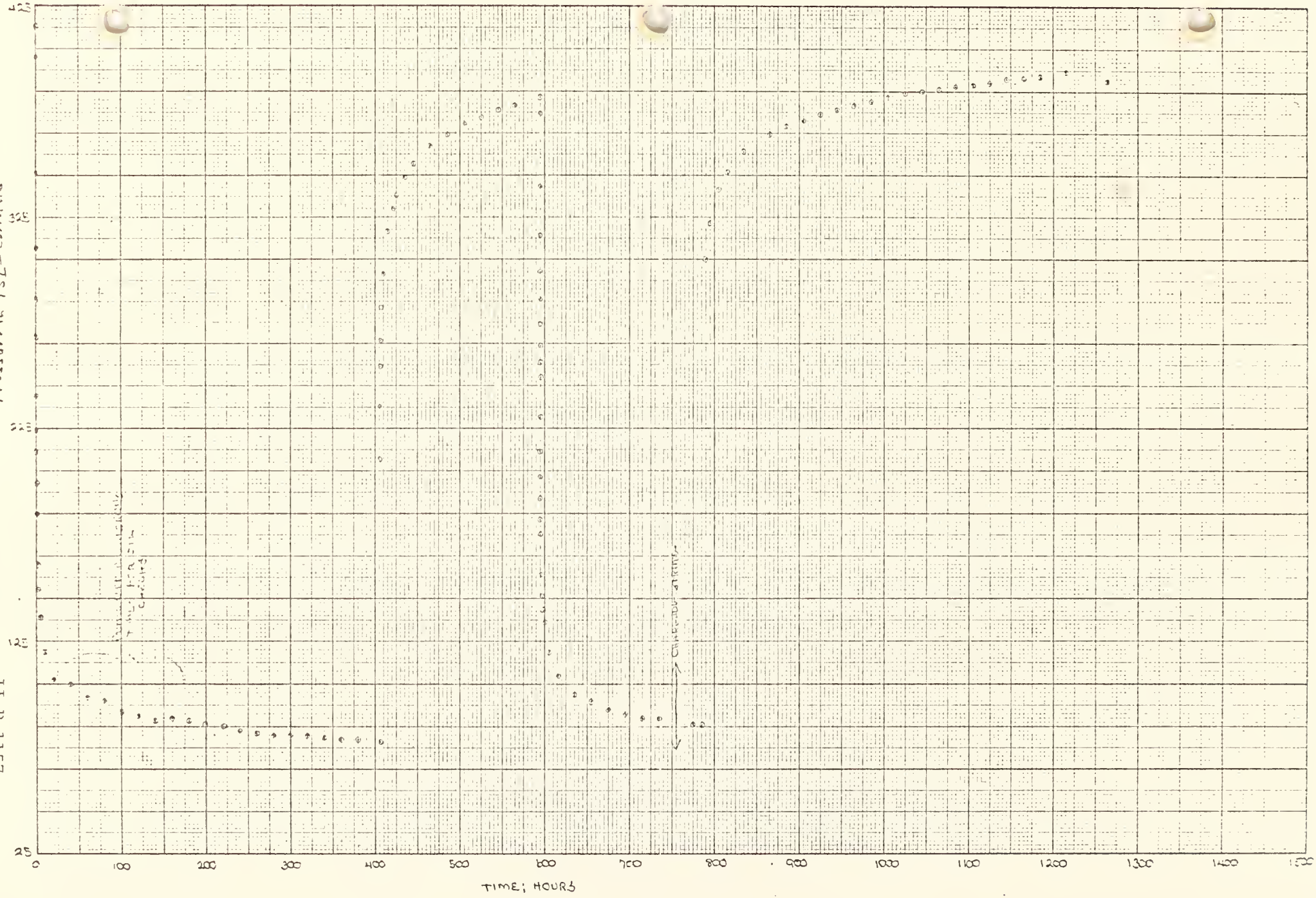
K+E 20 X 20 TO THE INCH 47 1242
10 X 10 INCHES 7 X 10 INCHES
KEUFFEL & ESSER CO.


LOWER ACQUIFER PUMP TEST : AT-1D STRIDE
TIME; HOURS
Pressure in PSI - Corrected
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
250
300
350
400
450

LOWER AQUIFER PUMP TEST : AT-10 STRING #2



LOWER AQUIFER TEST / AT-1



K&E 20 X 20 TO THE INCH 47 1242
10 X 10 TO THE INCH 47 1244
KEUFFEL & ESSER CO.

Litholo

Lower Aquifer Pump Test

AQUIFER DATA

ALLUVIAL WELL PUMP TEST

TABLE II B-55

ALLUVIAL WELL A#1 PRODUCTION 6.11 gpm
Measured 4-23-75 Starting 1129 hours
Static Water Level 46.82 ft.

Drawdown		Recovery	
Column #1	Column #2	Column #1	Column #2
time of measurement from 0 = 1129 hours + minutes	drawdown in feet (-) from 0 = 46.82 feet below land surface	time of measurement from 0 = 1309 hours + minutes	recovery in feet (-) from 0 = 46.82 feet below land surface
0	0	0	0
1	0.59	1	.55
2	0.63	2	.62
3	0.675	3	.66
4	0.70	4	.68
5	0.705	5	.70
6	0.715	6	.71
7	0.730	7	.71
8	0.730	8	.72
9	0.730	9	.72
10	0.725	10	.725
12	0.735	12	.73
14	0.740	14	.74
16	0.745	16	.75
18	0.745	18	.75
20	0.745	20	.76
25	0.745	25	.76
30	0.750	30	.76
35	0.750	35	.76
40	0.755	40	.765
45	0.755	45	.77
50	0.755	50	.77
60	0.755	60	.77
70	0.760	70	.77
80	0.765	80	.77
90	0.760	90	.77
100	0.762		
120	0.760		
140	0.760		
160	0.760		
180	0.750		
temperature 12.5°C	conductivity 2200 ohms		

TABLE II B-56

ALLUVIAL WELL A#2 PRODUCTION 6.11 gpm
Measured 4-14-75 Starting 13:05 hours
Static Water Level 14.06 ft.

Drawdown		Recovery	
Column #1	Column #2	Column #1	Column #2
time of measurement from 0 = 13:05 hours + minutes	drawdown in feet (-) from 0 = 14.06 feet below land surface	time of measurement from 15:45 hours + minutes	recovery in feet (-) from 0 = 14.06 feet below land surface
0	0	0	5.72
1	2.8	1	3.0
2	3.25	2	2.15
3	3.7	3	1.79
4	3.93	4	1.59
5	4.03	5	1.40
6	4.15	6	1.27
7	4.29	7	1.16
8	4.37	8	1.18
9	4.47	9	1.12
10	4.56	10	.95
12	4.77	12	.83
14	4.94	14	.75
16	5.04	16	.69
18	5.12	18	.63
20	5.20	20	.58
25	5.28	25	.48
30	5.41	30	.40
35	5.47	35	.33
40	5.55	40	.28
45	5.60	45	.25
50	5.60	50	.21
60	5.58	60	.15
70	5.67	70	.10
80	5.68	80	.05
90	5.69	90	.05
100	5.69	100	.01
120	5.72	120	-.03
140	5.74	140	-.05
160	5.76	160	-.07
180	5.72	180	-.09
200	5.67	200	-.10
220	5.67	220	-.11
240	5.72	240	-.12
average temperature 11.0°C	average conductivity 1300 ohms		

TABLE II B-57

ANALYTICAL SUMMARY

ALLUVIAL WELLS

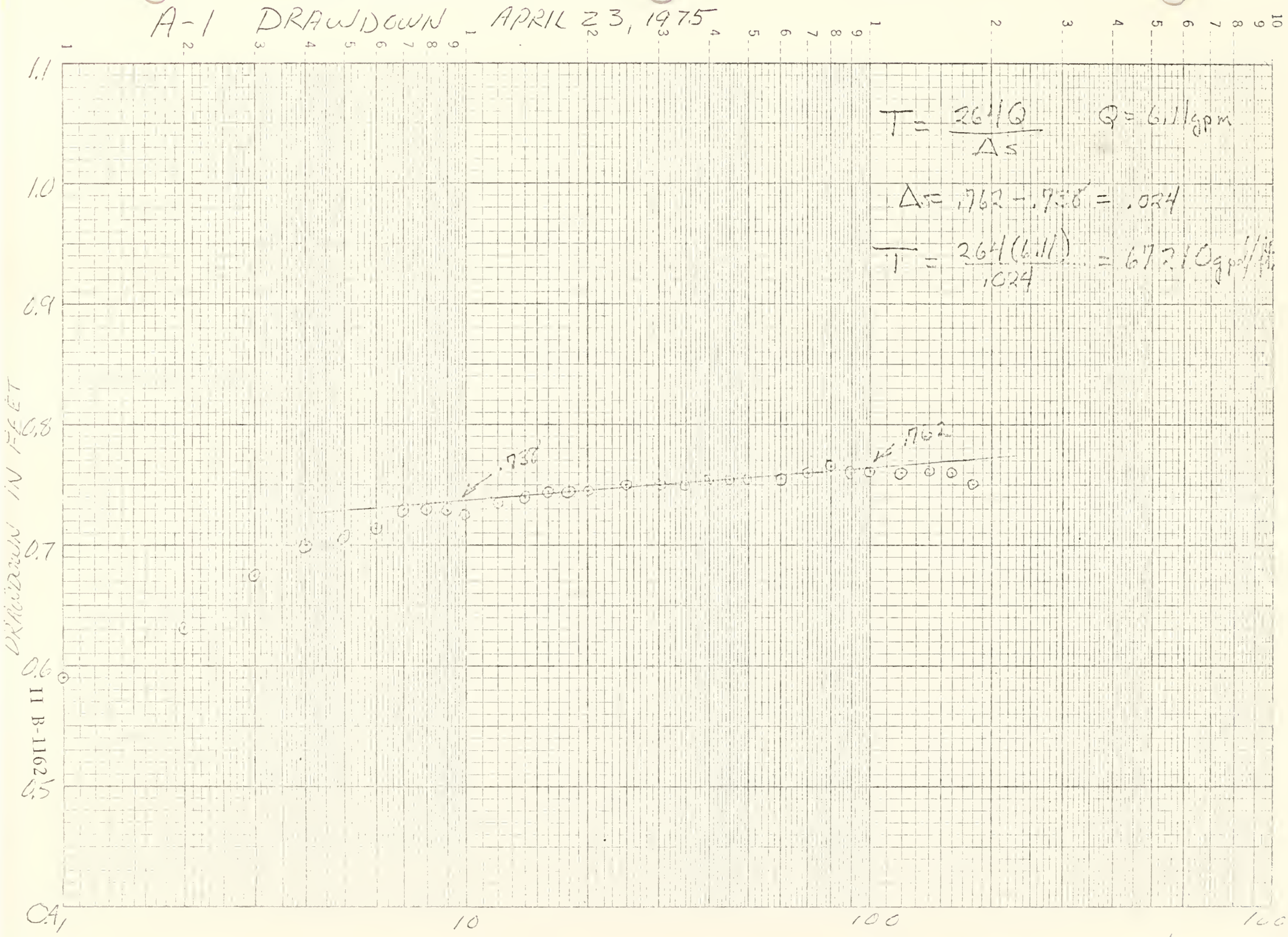
#A1	-	Drawdown (late data)	T	=	67,210 gpd/ft.
		Recovery (early data)	T	=	10,082 gpd/ft.
#A2	-	Drawdown (early data)	T	=	881 gpd/ft.
		Recovery (late data)	T	=	2,688 gpd/ft.

The range between early and late data analyses is the result of hole effects on the early data in general; the late data of these analyses will be the figure used.

K+E SEMI-LOGARITHMIC • 3 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 5493

A-1 DRAWDOWN APRIL 23, 1975



$T = \frac{264Q}{\Delta s}$ $Q = 6.11$ gpm

$\Delta s = .762 - .738 = .024$

$T = \frac{264(6.11)}{.024} = 67210$ gpd/ft

B-11162

K+E SEMI-LOGARITHMIC • 3 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 5493

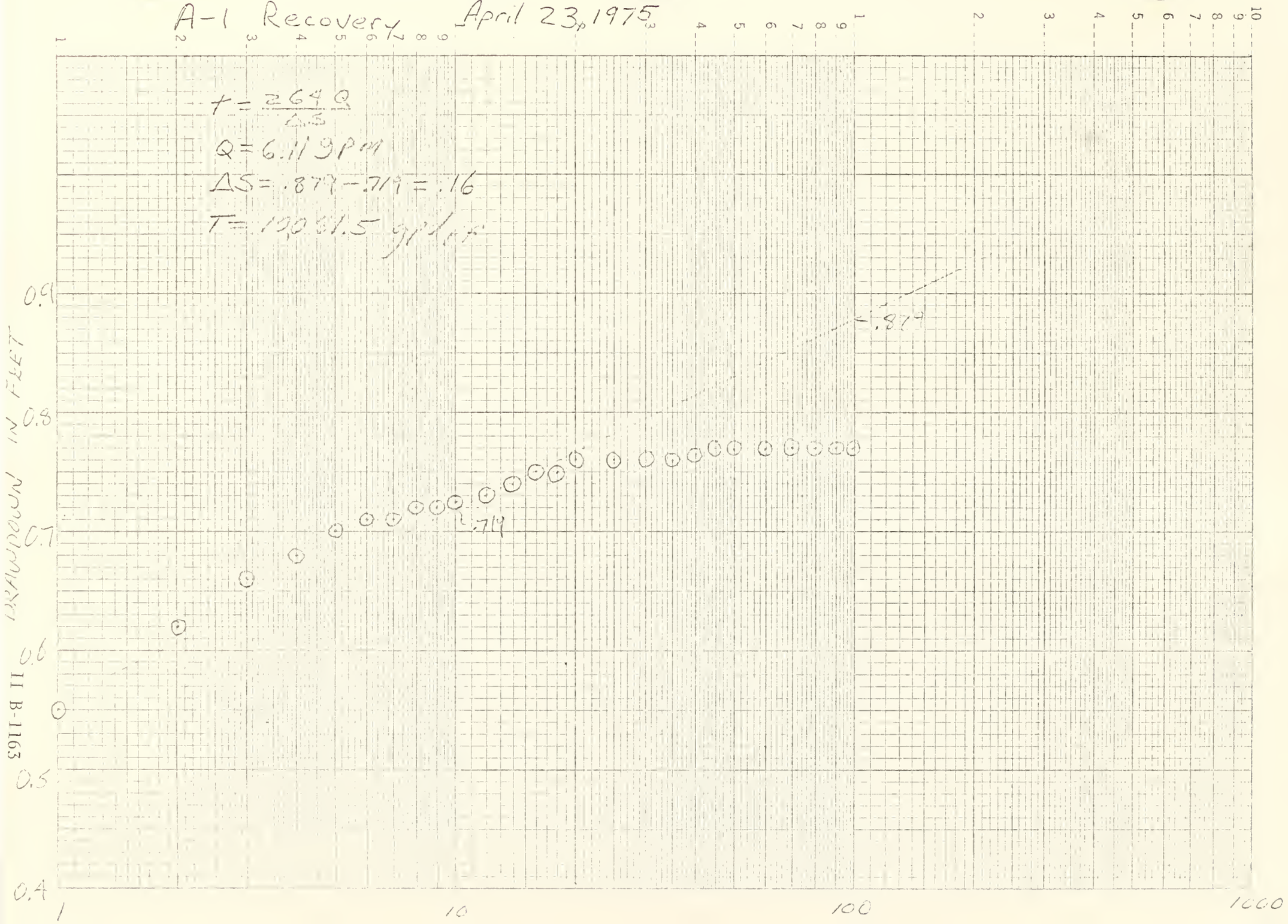
A-1 Recovery April 23, 1975

$T = \frac{264\,Q}{\Delta S}$

$Q = 6.11$ gpm

$\Delta S = .879 - .719 = .16$

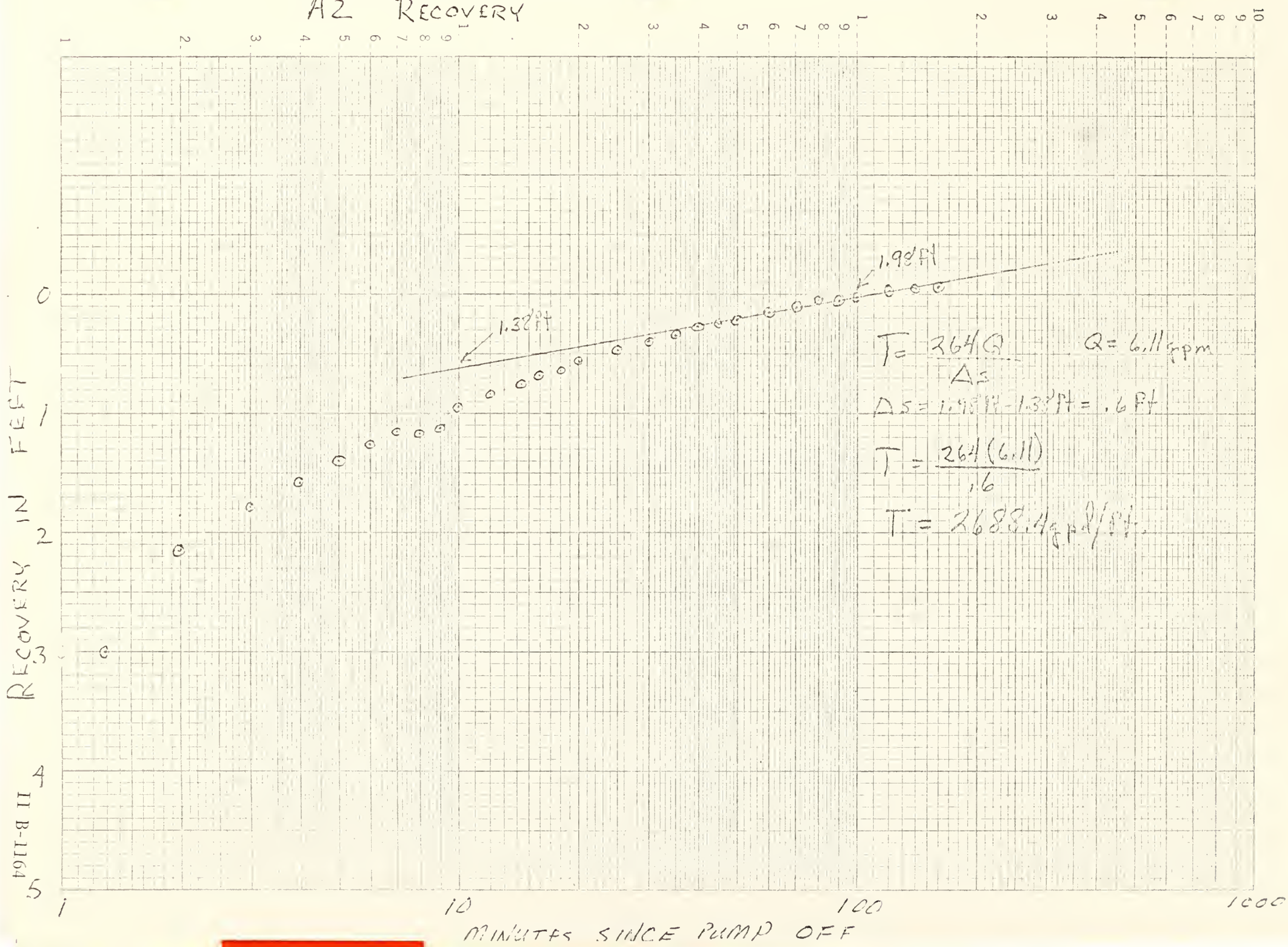
$T = 19{,}081.5$ gpd/ft



K+E SEMI-LOGARITHMIC • 3 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 5493

A2 RECOVERY



$T = \frac{264Q}{\Delta s}$ $Q = 6.11$ gpm

$\Delta s = 1.98\,ft - 1.32\,ft = .6\,ft$

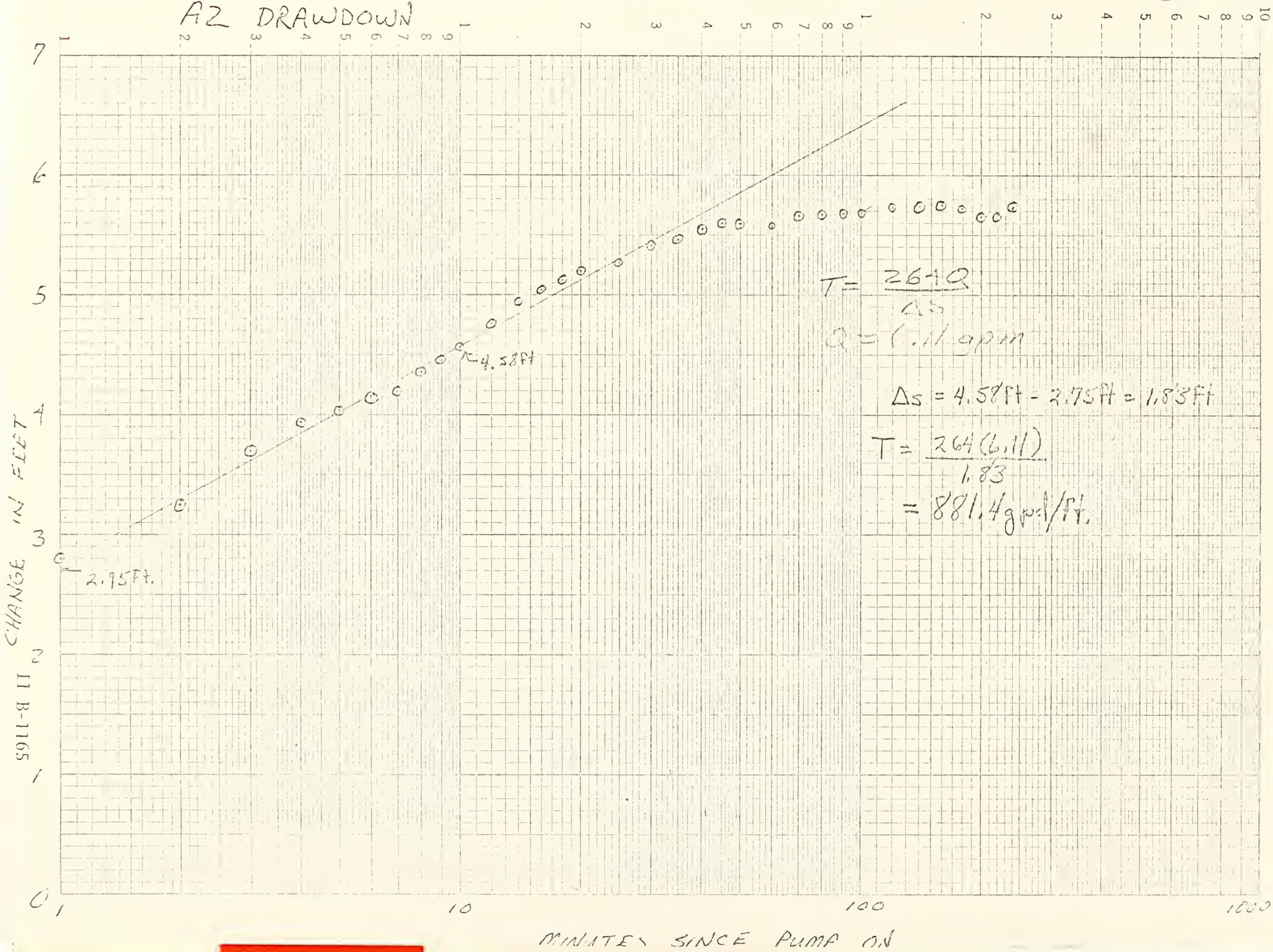
$T = \frac{264(6.11)}{.6}$

$T = 2688.4$ gpd/ft.

II B-1164

K+E SEMI-LOGARITHMIC • 3 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 5493

A2 DRAWDOWN



11 B-1165

J. Mahio

A-1

DATE: APRIL 23, 1975 STARTING TIMING: 11:29 A.M.

STATIC WATER LEVEL: 46.82 SAMPLE TAKEN: YES

DRAWDOWN (in feet)

IN	ΔH_2O LEVEL	TEMP.	CONDUCT	GPM	MIN	H_2O LEVEL	TEMP.	CONDUCT.	GPM
0	0.0				90	0.760			
1	0.59				100	0.762			
2	0.63				120	0.760			
3	0.675				140	0.760			
4	0.70				160	0.760	12.5	2200	6.11
5	0.705				180	0.750			
6	0.715				200				
7	0.730				220				
8	0.730				240				
9	0.730								
10	0.725								
12	0.735								
14	0.740								
16	0.745								
18	0.745								
20	0.745			6.11					
25	0.745								
30	0.750								
35	0.750								
40	0.755								
45	0.755			6.11					
50	0.755								
60	0.755								
70	0.760								
80	0.765								

RECOVERY (in feet)

		MIN.	ΔH_2O LEVEL	MIN.	ΔH_2O LEVEL
0	0				
1	.55	20	.76	160	
2	.62	25	.76	180	
3	.66	30	.76	200	
4	.68	35	.76	220	
5	.70	40	.765	240	
6	.71	45	.77		
7	.71	50	.77		
8	.72	60	.77		
9	.72	70	.77		
10	.72.5	80	.77		
12	.73	90	.77		
14	.74	100			
16	.75	120			
18	.75	140			

J. Martin

A 2

DATE: APRIL 14, 1975 STARTING TIMING 1305 Hours

STATIC WATER LEVEL: 14.06' SAMPLE TAKEN: YES

DRAWDOWN (in feet)

IN	Δ H_2O LEVEL-in ft.	TEMP.	CONDUCT	GPM	MIN	H_2O LEVEL	TEMP.	CONDUCT.	GPM	
0	0				90	5.69	11.0	1300	6.11	55 gal/9 min.
1	2.8				100	5.69	11.0	1300	6.11	"
2	3.25				120	5.72	11.0	1300	6.11	"
3	3.7				140	5.74	11.5	1300	6.11	"
4	3.93				160	5.76	11.0	1300	6.11	"
5	4.03				180	5.72	10.5	1300	6.11	"
6	4.15				200	5.67	10.5	1300	6.11	"
7	4.29				220	5.67	10.5	1300	6.11	"
8	4.37				240	5.72				
9	4.47									
10	4.56									
12	4.77									
14	4.94									
16	5.04									
18	5.12									
20	5.20									
25	5.28	11.5	1250							
30	5.41			6.11						
35	5.47									
40	5.55	11.0	1300	6.11						
45	5.60									
50	5.60	11.0	1300	6.11						
60	5.58									
70	5.67	11.0	1300	6.11						
80	5.68	11.0	1300	6.11						

RECOVERY (in feet)

0	5.72	MIN.	Δ H_2O LEVEL	MIN.	Δ H_2O LEVEL
1.3	3.0	20	.58	160	-.07
2	2.15	25	.48	180	-.09
3	1.74	30	.40	200	-.10
4	1.59	35	.33	220	-.11
5	1.40	40	.28	240	-.12
6	1.27	45	.25		
7	1.16	50	.21		
8	1.18	60	.15		
9	1.12	70	.10		
10	.95	80	.05		
12	.83	90	.05		
14.35	.75	100	.01		
16	.69	120	-.03		
18	.63	140	-.05		

Lithologic Logs

II B-10 LITHOLOGIC LOGS

The lithologic logs present a description of rock types encountered in a core hole. The detail of description varies with depth and operation. In most cases, however, the lithology is described from drill cuttings on ten-foot intervals above the "A" groove. In the lower zones, the lithology is described from cores on one-foot intervals.

In addition to providing a means for describing lithology, the litholog presents data such as information on structural dip, joints, fractures, and general rock quality data. These data are entered in the lithologic log at the appropriate depth.

The final lithologic logs for the following wells are included in this section of the Third Quarterly Report:

AT-1a	SG-10
SG-1	SG-11
SG-6	SG-17
SG-8	SG-18
SG-9	SG-19

For information on lithologic logs compiled for other wells, refer to the Well Summary Table II B-1.

LOGS CONSIDERED SENSITIVE

ASK PERMISSION OF AOSS TO SEE LITH. LOGS